The Electrical World.

VOL. XXIX. NEW YORK, APRIL 17, 1897. No. 16.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

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253 Broadway, New York.

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CONTENTS.

Editorial 495
The Probable Decision of the Berliner Case, by E. F. Frost 497
Testing the Field Coils of a Street Railway Motor Without the Use of Instruments, by Frank B. Porter 498
The Calculation of Wires for Magnets, by George T. Hanchett 499
Electric Power and Heating Plant at the Rothschild Shirt Factory, Trenton, N. J. 500
Connections of Railway Generators, by J. E. Woodbridge 503
Controlling the Speed of Car Motors—II., by Wm. Baxter, Jr 503
Electric Elevators—III 506
Financial Practice and Engineering Methods of American Street Railways 507
Digest of Current Electrical Articles, Compiled by Carl Hering 509
Well-Known Electric Wire Works 513
Fan Motor 513
Direct-Current Multipolar Machines 513
Rontgen Ray Machines 514
Waterproof Hydraulic Packing 514
Fan Motors 514
A Storage Battery 515
Improved Form of Trolley Wire Hanger 515
Quick-Break Switch 515
Departments:
Financial Intelligence 516
Special Correspondence 516
General News 519
Personal Notes 520
Trade and Industrial Notes 521
Business Notices 521
Illustrated Record of Electrical Patents 521

SUBURBAN TRACTION.

The lecture on "Street Railway Economics and Other Subjects," recently delivered by Mr. E. E. Higgins, of which an abstract appears in another column, contains a suggestion for a system of suburban traction to be operated by existing steam railroads in order that they may retain their profitable local business. The active competition of electric railway lines in the Eastern States, where cities and towns are close together, has seriously affected the profits of the steam railroads, which are gradually losing their control of the short-distance suburban and interurban traffic. The suggestion is that these railroads equip their lines, or parallel lines, with electricity and multiply the number of their stations.

On tracks laid upon the steam railroad rights of way, or upon the present steam tracks, speeds could be easily attained that would be out of the question on a highway. The grades and curves of the railroads are generally far less difficult than those of the highways, and the privacy of the right of way, unobstructed by wagon traffic, bicycles or foot passengers, permits the use of any attainable and controllable speed.

The desiderata for suburban traction are that the stations shall be close together, that the trains shall stop and start promptly, and that the average speed should be as high as possible. This, of course, means that the speed between stations should be very high. On steam railroads having stations about one mile apart the suburban accommodation trains rarely exceed an average speed of twenty miles per hour, and frequently fall considerably below this.

There is no question that between two roads operating at this average speed, that which has the greater number of stations in a given distance will be more attractive to suburban residents. Of two roads alike in respect to the situation and distances of stations, that which gives the faster service will attract the greater amount of travel. All other conditions being alike, the road which runs its trains most often will carry the greatest number of passengers. The essentials for the ideal suburban service, therefore, seem to be threefold—high speeds, frequent trains and many stations in the residential districts through which they run.

Given the clear right of way and easy grades of the steam railroad, the electric motor train can fulfill these conditions more nearly than the steam-driven train. With single cars or trains of two or three cars, started at such frequent intervals that the commuter would have no occasion to memorize a schedule, quickly attaining a high speed, running without the smoke and other nuisances of the steam locomotive, and making frequent stops so that no dwelling along the line could be out of easy walking distance from a station, the electric service would be incomparably better than that now furnished.

The earning power of such a system would increase in a geometrical ratio with the speeds attained. Every increment of average speed would extend the suburban area, and every increase of facility in reaching suburban points would enlarge the number of people residing at them. Combining with such a system a method of uniform fare rate, or the zone system, would certainly bring about a great expansion of the cities affected and an enormous increase in the suburban traffic.

ELECTRIC HEATING.

Among the newer developments of the electric industries the art of electric heating bids fair to become important and prominent. For certain specific purposes the perfection of regulation possessed by electrically developed heat and the ease with which it may be applied to various forms of implements and machines render it highly valuable, and may lead to new applications, as it has already furnished the means for important industrial discoveries.

The article in another column describing the application of electrical methods of heating in the manufacture of shirts, etc., furnishes an extremely interesting illustration of their possibilities. The electrically heated irons and machines described are manipulated by an unskilled class of labor, and demonstrate, by their successful use, the solidity and permanence of their design, as well as their ease of operation.

The fact that so extensive a plant is in existence, and that it was installed by a firm whose large business experience entitles its judgment to respect, is a very convincing proof that, for this particular industry at least, electrical heating methods are better than any others available. It marks the opening of a new field for electrical enterprise, and may be the first of an important series of industrial undertakings.

For several years the electrical heating of street-railway cars has been carried on successfully, and electrical cooking utensils, soldering irons, and the like have become common. In the production of very high temperatures the electric furnace has no rival, and its use has already given aluminum, carborundum and the carbides to the arts. It seems likely that there will be an increasing use of both high and moderate temperature electric heating in many directions, and more than possible that new, and as yet unthought of, developments in these directions may soon eventuate.

EXPEDIENTS IN ELECTRICAL MEASURING.

A rough-and-ready means of testing the field coils of a street railway motor, when the usual instruments are not available, is described by Mr. Frank B. Porter elsewhere in this issue. The method is not claimed to be as accurate in its results as the more elaborate test with proper instruments, but for ordinary purposes it is fairly so, and as an expedient it has sufficient merit to entitle it to the consideration of those interested. It certainly gives more positive indications than can be obtained ordinarily by the bridge test, for the reason that the regular working current may be used in making the test, thus developing the fault, if there be any, under actual service conditions. In the bridge test the current is of much lower voltage and not as likely to reveal faults in the field coils of a motor as readily as if it were of greater pressure. Indeed, in some cases it is doubtful if satisfactory results can be obtained at all by the use of the bridge test, because of the inadequacy of the comparatively feeble currents to produce a stress upon the insulation equal to that which obtains in actual conditions of practice.

Mr. Porter's method commends itself for its extreme simplicity, the only instrument necessary to give indications being an ordinary compass An interesting fact which impresses itself upon the mind in this connection is that the compass needle, after all, is indispensable in electrical tests, and the importance of Oersted's historic discovery is thus most forcibly exemplified. We find the compass needle or its equivalent in all forms of testing instruments for direct currents, and nothing approaches it for accuracy. The telephone may be used in many instances to verify the existence of a fault, but, of course, its indications are those of existence only, and not of magnitude; whereas, the magnetic needle enables both to be determined.

Another noticeable fact about this method is that it is practically a form of bridge or balance, the electro-magnetic influence of the defective coil upon the compass needle being balanced against the like influence of a perfect, standard coil. This, again, takes us back towards original conceptions, and emphasizes the great practical utility and universal application of the fundamental principles of the bridge system of measurement.

THE PHANTOM AIR-SHIP.

For two or three weeks the daily press has been filled with accounts of a marvelous aerial portent, which has traversed Iowa, Missouri, Wisconsin, Illinois and adjacent parts of the country, spreading consternation and furnishing the basis of several religious revivals in the region over which its baleful influence extended. The published accounts differ in all respects, save that there is a remarkable unanimity of agreement that the object is an "air-ship" of gigantic proportions.

According to the newspapers this strange fabric is provided with a searchlight, steering lights, wings, a cylindrical body, and an amazing speed, which accounts for its nearly simultaneous appearance at points many miles apart. It has been seen, so the story runs, by hundreds of reliable witnesses, both by day and by night, observed through telescopes, opera glasses, etc., and most voluminously discussed. The estimable M. Jules Verne has been beaten on his own ground.

There seems to be no doubt that some phenomena of an unusual kind have been seen, but that the "air-ship" should spring full-fledged into existence, modestly concealing its origin and solving at one essay all the problems that beset aerodromic investigators, savors strongly of a hoax. The time for aerial navigation, on this scale, at least, is not ripe. Maxim, in England, and Langley, in this country, have constructed, after most diligent and costly research, machines that actually fly, and Lilienthal, in Austria, met his death recently by an accident while actually flying. None of the results of these really scientific investigators, nor the data they gathered, warrants the belief that a successful aerodrome of large size can be constructed at this time, or if constructed could be operated until long and dangerous experience had taught its helmsmen how to fly.

The Western Union Telegraph Company vs. The Bell Telephone Company.

The United States Supreme Court, on April 12, according to a Washington dispatch, denied the motion of the Western Union Telegraph Company for a writ of certiorari to bring up for review the record of the suit of the Western Union Telegraph Company against the Bell Telephone Company before the Court of Appeals from the First Circuit. The suit was begun in 1883 by the Western Union Telegraph Company, the American Speaking Telephone Company, the Gold and Stock Telegraph Company and the Harmonic Telegraph Company, demanding an accounting for royalties claimed to be due by the American Bell Telephone Company, amounting to about $5,000,000. The complaint was ordered to be dismissed by the Court of Appeals, and that order, by virtue of the Supreme Court decision, now stands final. This case refers to the old contract between the American Bell Telephone Company and the Western Union Telegraph Company, under which the latter was paid 20 per cent. of the royalty on Bell telephone instruments. The Western Union Company contended that it should share in the Bell Company's receipts from dividends in sub-companies, alleging that the Bell Company had reduced the royalties to sub-companies and received increased dividends therefrom.

Stealing Electricity.

The Connecticut House of Representatives at Hartford has passed a bill providing for punishment for stealing electricity. The penalties for this offense are similar to those provided for stealing gas.

The Probable Decision in the Berliner Case.

BY E. F. FROST.

In previous articles I have made the statement that it is a quite general opinion among attorneys that the Government will lose its suit to annul the Berliner patent of 1891 on the first count, this opinion being that the Government has no power to bring such a suit. In fact, this opinion agrees completely with the contention of the counsel for the defendants. The attorneys express no opinion, however, as to what will be the result if the Government is sustained on the first count.

Ignoring such opinion, I have sought whatever might be found to serve as a basis for independent opinion and from such findings to attempt to forecast the outcome of the case at bar.

The Government will win its suit to annul the Berliner patent on every count.

It will be first decided that the Government has power to bring such suit to annul a patent, and in support of this position there will be cited the following:

In United States vs. Telephone Company, *supra*, it was decided that "where a patent for a grant of any kind issued by the United States has been obtained by fraud, by mistake or by accident, a suit by the United States against the patentee is the proper remedy for relief and that in this country, where there is no kingly prerogative, but where patents for land and inventions are issued by the authority of the Government and by officers appointed for that purpose, who may have been imposed upon by fraud or deceit, or may have erred as to the power, or made mistakes in the instrument itself, the appropriate remedy is by proceedings by the United States against the patentee." (United States of America vs. American Bell Telephone Company and Emile Berliner; decided November 11, 1895.)

This decision leaves no room for doubt as to the outcome of the case on the first count.

The second count, charging fraudulent delay in the prosecution of the patent application, will be decided in favor of the Government on the evidence of a purposive inaction as to the demanding of the issue of the patent when all obstacles thereto were removed, and that such inaction extended beyond the time allowed by statute; also on the evidence that the defendant acquiesced in every obstruction suggested by the Government officials which would promote delay in its issue.

The third count will likewise be decided in favor of the Government. This count is to the effect that the 1880 and 1891 patents to Berliner are for the same invention and issued to the same applicant, the 1891 patent being broader than and inclusive of the 1880 patent.

This count is based on the fourth claim of the 1880 patent, which reads as follows: "Claim 4. A system of two or more telephone instruments in electrical connection with each other, each consisting of two or more poles of an electrical circuit in contact one with the other, either or both poles of each instrument being connected with a vibratory plate, so that every vibration which is made at one contact is reproduced at the other, substantially as set forth"—together with the first and second claims of the 1891 patent.

The defense against this count was an attempt to show that the two patents were not for the same identical invention, the defense declaring that the 1880 patent was for an invention for a *combination* of a multiplicity of identically alike instruments to achieve a new result. For this reason the fourth claim of the 1880 patent is quoted above, that the reader may search therein for a new *combination* or for an invention of any combination in fact, other than that of the 1891 patent.

The decision of the United States Supreme Court in Miller *et al.* vs. Eagle Manufacturing Company, 151, U. S., 186, will leave no opportunity for the court to decide this count other than against the defendant.

It is most interesting to read the above-mentioned decision substituting the Berliner patents for those of Wright, and note the exactly complete parallel.

The fourth count was argued by brief alone and charged that the 1891 patent is not for the same invention which was described in the application as filed.

The answer by brief by the defendants is the most astute avoidance of the question in dispute that can be imagined. In this answer there is the most profound semblance of meeting the contention, but it is mere semblance. There is, however, the most delicate finesse of sophistry in making points beside the question to appear to be the real question in dispute. Men of straw are most skillfully erected and then with great acumen are totally shattered.

The complainants, to use an illustration, have said that the application was for a wheeled vehicle without tires, but that the patent was issued for a wheeled vehicle with tires. The defendants merely maintained that the contention was as to whether the patent was for iron or steel tires, and in discussing this point made it seem to show that the application was for a wheeled vehicle with tires.

It seems clear that the finding of the court on this count will be for the complainant.

The next and last count is: "That taking the application to date from the time when it was made by amendment to cover the invention described and claimed in the patent as issued, it was barred by public use for more than two years." This count was also argued by brief alone.

The complainants show that the broad claim for electrodes in constant contact was not the matter of the application as filed and that it did not appear in the application until 1880, and that electrodes in contact had been in use for more than two years before this time, notably in the Edison and Blake transmitters. Moreover, the complainants' argument showed that the broad claims of the Berliner 1891 patent were clearly anticipated by the Bell 1876 patent as to the liquid transmitter.

The defendants set up that from the very beginning of its history the Berliner application was recognized by the Patent Office officials to be for electrodes in constant contact, totally ignoring the facts in the case, namely, that the opposite was contended by these very officials, as appears in the record.

On this count the decision will be for the complainant.

The above conclusions are given as the result of my study of the case, and are but my individual opinion in the matter.

A few remarks may be in order concerning the identity of the 1891 and 1880 patents to Berliner.

The court may possibly consider the 1880 patent as a mere aggregation and not a combination, or it may consider it as merely a double use of a given instrumentality.

Even should the opinions above expressed be not all realized, it is clear that a decision on any one count, besides the first, in favor of the Government will render the Berliner 1891 patent void.

Permits Granted for Railway Conduit Construction in New York City.

The Commissioner of Public Works for New York City has granted to the Metropolitan Street Railway a permit to change the motive power on the Eighth Avenue Railroad from horses to underground trolley, and it is understood that a similar permit for the Sixth Avenue line will be forthcoming in a few days. This action removes the last obstacle in the way of the construction of the proposed roads and work upon them will be begun at once.

The Corporation Council of the city has given advice that this action will not invalidate any rights the city may have to buy the railroads in Sixth and Eighth Avenues. He has also advised the city that while it may have the right to buy these railroads, it has no money for such a purchase, nor any authority to issue bonds to raise it.

It is, therefore, likely that the offer of the Third Avenue Railroad Company to pay the city a bonus of one million dollars for the transfer to it of the two railroad franchises in question will not be accepted.

Texas Gas and Electric Light Association.

The third annual meeting of the Texas Gas and Electric Light Association will be held in the Menger Hotel, San Antonio, Tex., on the 19th, 20th and 21st of April. The railroads have offered a rate of one and one-third fares for the round trip on the certificate plan. The Committee on Exhibits have arranged an excellent array of gas and electrical appliances, and many papers of interest and importance will be presented. A novel and very interesting feature will be the "question box." A number of questions have been submitted for general discussion, and many of them will doubtless provoke exceedingly interesting replies. Those intending to attend the meeting should notify the secretary, Mr. F. R. Starr, Jr., Gonzales, Tex.

Testing the Field Coils of a Street Railway Motor Without the Use of Instruments.

BY FRANK B. PORTER.

Where instruments with which to test the resistance of the field coils of a street railway motor are not available, the following simple methods will enable the person applying them to determine whether a coil is short-circuited in some of its layers, or is of too high resistance. In practice the results obtained by using these methods, while not equaling those obtained by the use of the voltmeter and ammeter, will be found superior to those derived from the use of a bridge, as higher voltage and more current can be used than are practical in the bridge as ordinarily designed, making the condition of the field being tested in regard to differences of potential and current passing equal to actual service.

An amount of current can be sent through the field equal to the maximum amount passing at any time when the motor is in service, and as an increase in current increases the difference in potential between layers of the field coil winding, any charred or faulty insulation will be more apt to break down under the stress and a short-circuit result, while with feeble currents of low voltage, such as are generally employed in bridge work, very inferior insulation is effective in confining the current to the convolutions of the wire.

Take the field coil to be tested, X (Fig. 1), and place it so that its plane extends north and south, and the direction of its lines of force when excited will be east and west, *i. e.*, place it so that, when excited, its north and south pole will be directly in the east or west of the compass N. S. (N. and S. being its north and south poles respectively), whose needle should be parallel to the plane of the coil. Connect the coil in series with a resistance, or multiple lamp exicted, its north and south pole will be directly to the east or west

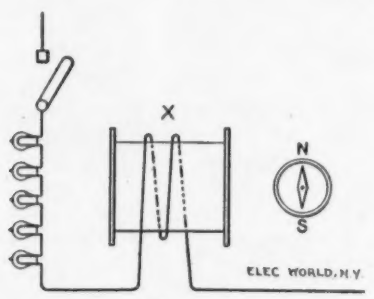


Fig. 1.

test. Closing the circuit by means of a switch, note which pole of the compass needle is attracted toward the field coil. Now, placing a similar, but standard, field coil (See Fig. 2) on the opposite side of the compass, with its centre directly opposite the centre of X, and equally distant with X from the centre of the compass, send a current through it in such a direction as to cause it to attract the same pole of the compass needle as did X in the first place. By connecting both field coils in series so that the current will pass through them in the same direction, it is obvious that each is attracting the same pole of the compass needle, and as the needle is at an equal distance from each, it is also obvious that if the attractive force of each be equal, the compass needle will not be deflected. If, however, one field coil be stronger than the other, it will attract the pole of the needle in its direction. Should this be the case, move the compass away from this field, and toward the weaker, until a neutral point is found. As the magnetic strength of the coils is proportional to the square of the distance between them and the compass, if one coil, when the neutral point is found, is twice as far from the compass as the other, this coil will be four times as strong as the other, and the nearest coil would undoubtedly be short-circuited in some of its layers.

Next, connect the coils in parallel (Fig. 3) or multiple, but opposing each other as before, and if the neutral point is found nearer one than the other, the nearer one has a higher resistance than the other, caused by a faulty connection or broken wire. In connecting the coils in multiple care must be taken to make good connections between the test wires and the field terminals, or the result cannot be depended upon. In the first case, when they are in series, a poor connection will not so materially affect the result.

As the magnetic strength of the coil is proportional to the product of the number of its turns multiplied by the current passing through it, when the coils are connected in series (Fig. 3) the current is the same in each, and consequently if one is stronger than the other there must be more active turns in it than in the other, *i. e.*, some of the turns in the weaker coil must be short-circuited.

A high resistance connection in either coil would reduce the amount of current passing through the coils equally, and thus reduce the magnetic strength of each equally, and so would not be shown, the compass needle remaining undeviated. When the coils are connected in parallel, however, a connection of high resistance in one of them will reduce the current passing in that coil and increase it in the other, weakening the magnetic force of the one and increasing that of the other, as will be shown by the compass needle.

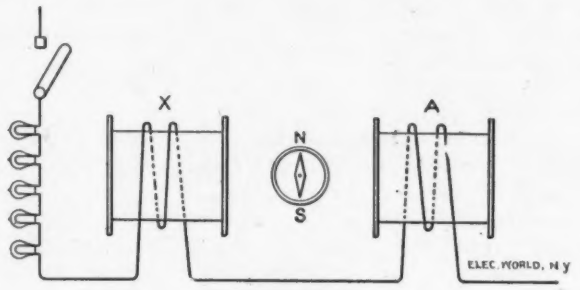


Fig. 2.

If, on the other hand, with the coils connected in parallel, a portion of the winding of one coil is short-circuited, the resistance of this coil will be lower, and more current will pass through it than through the other, so that the product of the current and the number of turns might remain the same, and their magnetic force equal. This, of course, would not be shown by the compass needle. To make sure of a coil it must be tested both in series and in parallel with another. The distance that the coils should be placed apart in order to give the best results will vary with the size and shape of the coils. Short coils of large area should be placed close together. Longer coils, of less area, may be placed further apart. A few trials will establish the distance which gives the best results for any particular form of coil. The compass with the field coils, as will be perceived, is a form of the differential galvanometer, and as the coils are at hand in the repair shop, all that is needed is a pocket compass. By designing a switch with which to make changes in the connections in testing, a graded scale with a compass to slide on ways back and forth, and a rack to hold the field coils in their proper position, a very practical and useful instrument would result.

The second method of testing field coils, derived from the first, is still more practical. It does not necessitate removing the coil to be tested from the motor, as does the first method, and for certain classes of motors gives excellent results. If it is thought that a field coil, in a motor on a car, is defective, cut out the good motor, leaving the car to run on the motor which has the defective coil. If

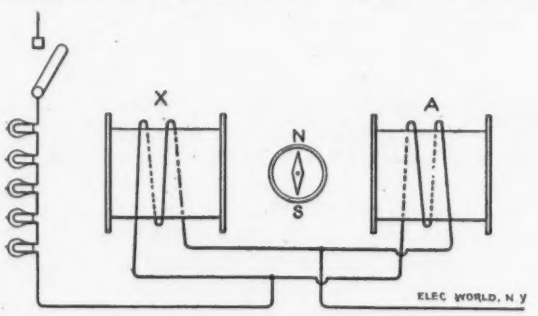


Fig. 3.

this motor has two field coils, say a top and bottom coil, disconnect the top coil and connect the bottom coil, so that the current will pass through it in the reverse direction. Go to the controller and turn on the current, when the motor should move in the opposite diretion from that for which its reverse lever is set.

The reverse lever being set to go ahead, connect the top field in series with the bottom, but in opposition to it; that is, as it was at first, so as to move the car in the direction for which the lever is set. Turn on the current again, and if the car should move in one direction or the other, one field is weaker than the other. If the car should move in the opposite direction from that for which the reverse lever is set, the top field is the weaker; if in the direction

for which the reverse lever is set, the bottom field is the weaker, and the weaker field will be found to be short-circuited in its windings. If the fields are about evenly balanced the armature will slowly turn until it takes up the play in the gearing, unless this be very new and close meshed, when there should be little play.

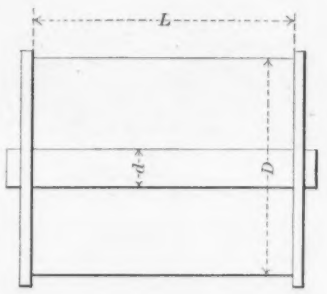
If the armature turns violently and with considerable force, taking up the play in the gears with a clash, there is considerable difference in the strength of the fields, although it may not be enough to cause a movement of the car. If in the above test the fields seem to be in good order, connect them in multiple and in opposition so that the weaker field will seem to have too high resistance. Care must be taken not to keep on the current too long when the fields of the motor are connected in opposition, or to cut out too much of the starting resistance. On the other hand, considerable current is necessary if one field is to cause the car to move, in opposition to the other.

A few trials will establish a safe notch of the controller as a maximum limit of starting resistance to be cut out. Care must also be taken to see that the brushes are in their proper position, if they are not so fixed immovably in the design of the motor. With much lead given them and the field coils evenly balanced, the armature will try to turn in one direction, no matter which way the reverse lever is thrown. In practice, using these last methods, the writer has known motors, in which the field seemed all right to external appearances, to start the car off at quite a lively pace. By taking off the armature pinion and using a system of levers connected to the end of the armature shaft, force might be applied, and measured accurately by an ordinary platform scale, such as is found about any shop. The above methods were used for nearly a year, part of this time conjointly with a bridge, by a street railway repair foreman at a station where over one hundred motor cars were kept in repair, and it is his experience that these methods, where the tests are made with care, are more reliable than the test of the resistance of a field coil by means of a bridge.

The Calculation of Wires for Magnets.

BY GEORGE T. HANCHETT.

A problem that frequently arises, especially in the construction of magnets for telephone and telegraph work, is the following: Given the dimension of the core, the distance between the heads and the dimensions of the finished coil, with what wire shall it be wound in order that its resistance shall be a certain predetermined quantity? The writer herewith submits a number of formulae for cores and coils of different sections, together with the meanings of their reference letters. For the benefit of those who are sceptical and those who are mathematically curious the deduction of the principal formula is also given, and from a similar train of reasoning the others may be deduced. The resulting formulae are usable and require no tables of logarithms or similar references. This deduction applies to coils of circular section.



Let

D equal the diameter of the coil.
d equal the diameter of the core.
L equal the length between the end collars.
R equal the total resistance of the coil.
t equal the thickness of the insulation on the wire.
$\triangle$ equal the diameter of insulated wire.
δ equal the diameter of bare wire.
r equal the resistance per inch of the proper wire.

All of these dimensions are to be in inches. The last two quantities are unknown. It is obviously necessary to find δ.

It is evident that the total resistance of the coil is equal to the total number of turns multiplied by the average length of a turn and by the resistance per inch of length.

The number of turns to a layer is equal to $\frac{L}{\triangle}$

The number of layers is $\frac{D-d}{2\ \triangle}$

The mean length of a turn is $\frac{(D+d)\,\pi}{2}$

and therefore

$R = \frac{\pi\, L\, r\, (D^2-d^2)}{4\triangle^2}$, the product of r and these three factors.

Transposing:

$$\frac{\triangle^2}{r} = \frac{\pi\, L\, (D^2-d^2)}{4\, R}$$

We have now to express the unknown quantities $\triangle$ and r in terms of δ and t and solve for δ.

$$\triangle = \delta + 2t$$

and

$$r = \frac{k}{\delta^2}$$

where k = the resistance of a wire one inch in diameter and one inch long, or 0.0000008651 ohm.

Calling $\frac{k\,\pi\, L\, (D^2-d^2)}{4\, R} = x$ and substituting, we have

$$\frac{(\delta + 2\,t)^2}{\frac{k}{\delta^2}} = \frac{\pi\ L\, (D^2-d^2)}{4\, R} \text{ or, } \delta^2\, (\delta + 2\,t)^2 = x.$$

Extracting the square root we obtain the equation

$$\delta^2 + 2\,\delta\, t = \sqrt{x}$$

This is the simplest of quadratics and its solution is

$$\delta = \sqrt{x^{1/2} + t^2} - t$$

Remembering that $x = \frac{k\,\pi\, L\, (D^2-d^2)}{4\, R}$ and that the value of $\frac{\pi\, k}{4}$ is 0.0000006794 we have

$$\delta = \left(\sqrt{\frac{0.0000006794\ L\, (D^2 - d^2)}{R} + t^2} \right)^{1/2} - t,$$ which is the required formula.

For square coils, of which D and d represent the respective diameter of coil and core, the formula becomes:

$$\delta = \left(\sqrt{\frac{0.0000008651\ (D^2 - d^2)\, L}{R} + t^2} \right)^{1/2} - t$$

For rectangular cores $a \times b$ surrounded by coils $A \times B$ in dimensions

$$\delta = \left(\sqrt{\frac{0.0000004323\ L\, (A-a)\ (a+b+A+B)}{R} + t^2} \right)^{1/2} - t$$

For cores consisting of a rectangle and two semicircles we have, allowing A to represent the length of the parallel sides of the coil, the other reference letters retaining their former significance:

$$\delta = \left(\sqrt{\frac{L[0.0000006794\,(D^2-d^2)+0.0000008651\,(D-d)\,A]}{R} + t^2} \right)^{1/2} - t$$

These formulae assume that the magnet is carefully wound, without spaces between the turns or paper between the layers. It is very easy to wind a turn or two short at the ends of the layers and thereby introduce a discrepancy, but if carefully done the winding should come out within one or two per cent. according to the conductivity of the copper. In any event the formula will point to the nearest size of any standard gauge with unerring accuracy.

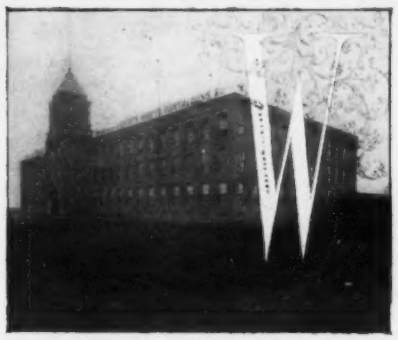
Index of Engineering Literature.

Prof. F. A. C. Perrine, in the first number of the *Engineering Journal* of the Stanford University, of California, outlined what appears to be a very good plan for publishing a practical card index of engineering literature. Those interested in the subject will do well to read the article.

An Interesting Subject.

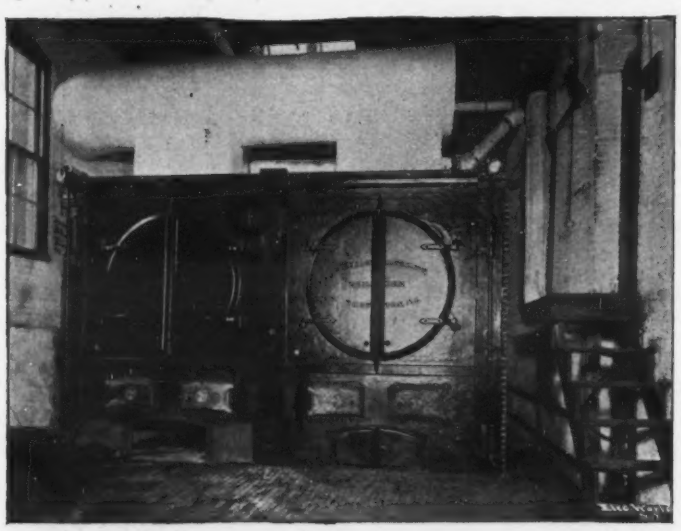
At a recent meeting of a German engineering society the topic of the evening was: "Elektroautomatischensicherheitspatenteisenbahnaborthuerenverschluss."

Electric Light, Power and Heating Plant at the Rothschild Shirt Factory, Trenton, N. J.



WHILE electric light and power distribution has been generally utilized in manufacturing establishments, it is not common to find a plant which combines the use of the electric current for light, power and heating, and in which this general combination forms a particularly economical feature of the establishment. Electric heating appliances have reached a thoroughly commercial and practical condition. In the general field of heating the electric current has, however, its particular place. For distributed heat there are other methods which may possibly surpass electricity in economy, although perhaps not in other features. When, however, concentrated heat is considered, then the electric heating appliance is far superior to any other for various obvious reasons. In no field is the concentrated heat feature more apparent than in laundry ironing apparatus. The utilization of electric ironing devices has already attained quite considerable prominence, and such devices are in more or less general use, but the recently completed electric plant in one of the largest shirt and waist factories is particularly prominent, as the electric heating feature predominates, and as much, if not more, electrical energy is used for heating than for either light or power. This plant is the waist and shirt factory operated by V. Henry Rothschild & Co., at Trenton, N. J.

The factory is located on the main line of the Pennsylvania Railroad. The building is of red brick, three stories high, and occupies a ground area of 225 feet front by about 100 feet deep to the end wings. The general floor plan of the building is in the form of the letter E. The building is very excellently and solidly constructed, the interior being of an improved wooden post and beam construction. A spur from the main line of the railroad runs along the side of the factory and to the back. The office, stock and shipping rooms are on the first floor, as is also the washing-room of the laundry. On the second floor are the sewing and cutting room and the paper box making department. On the third floor are the starching department and drying-room, the ironing and the matching and boxing departments. The factory employs about 400 operatives, most of whom are female, and the manufactured products consist entirely of shirt waists and shirts.

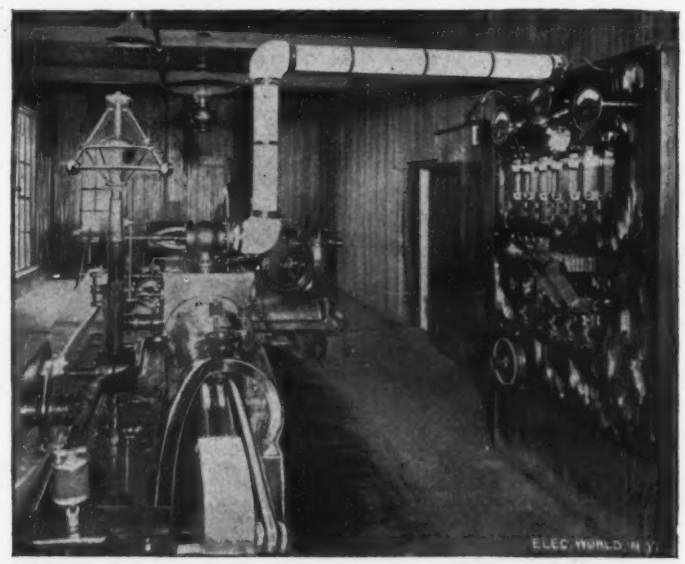


Boiler Room.

The power-house is situated in the rear of the main building between the two L's, and occupies a ground area of about 40 by 50 feet. It is divided into two, one half being occupied by the boiler-room, the floor of which is slightly below the level of the ground, and extends off under the engine-room floor to a pump room. The engine-room floor is on the ground level. The power plant consists primarily of a pair of boilers, Hewes & Phillips Corliss engine, Walker dynamo, switchboard, etc. Coal is taken in on the cars on the spur to the back of the engine and boiler room, and is dumped down an open pit to the floor of the latter, where it falls immediately in front of the boilers. There are two boilers, of the horizontal tubular type, each with drums 66 inches in diameter and 16 feet long, with 94 tubes. Each boiler has a capacity of about 100 horse-power. The smokestack is separate, on the exterior of the boiler-room, and the boiler draughts are connected therewith by a heavy iron flue.

The water supply comes entirely from an open well 10 feet in diameter, located back of the power-house, beneath the pump-room floor. Water is pumped from this well by a Deane duplex pump, located in the well 10 feet below the surface of the platform. For fire purposes water is fed to a large reservoir in the rear of the factory, holding 75,000 gallons, and from here it may be pumped to a fire tank on a tower 80 feet high. The main supply for house purposes is also furnished from this pump through a single 2-inch iron pipe. The boilers are fed by a Worthington duplex pump, feeding through a 2-inch pipe, which extends to the side of the boilers, where it divides into a separate properly valved feed pipe for each boiler, and at which point a single Metropolitan injector is located. From the top of the boilers extends a 4-inch steam main to which each boiler is fed and valved, one end of the main going to the engine and the other to the pumps. All live steam pipes are protected with asbestos and magnesia covering.

The entire factory building is protected by a fusible-sprinkler system which extends throughout the various sections. The heating system throughout the building for the general heating of the rooms consists of a large number of steam radiators, piped from the engine exhaust by a 6-inch riser, which extends to the top of the house, being branched on either floor to the heaters. The exhaust from the engines to the air is fitted with a back-pressure valve. A 4-inch pipe taps from the engine exhaust and goes through a Warren-Webster feed-water heater, which is ordinarily worked. The exhaust steam is sprayed on the feed-water, thereby being condensed and heating the latter. A Keily grease extractor is provided in conjunction with the heater. A condensation pump is also provided in the room where the boiler feed-pumps are located, which returns all condensation water from the heating system back to the boilers. This pump is controlled by a Keily governor.



Engine and Dynamo Room.

There is no shafting or belting in the factory except that which is operated by electric motors receiving power from the electric plant, which also furnishes electricity for lighting and concentrated medium high-temperature heating. It is to be noted that the plant is particularly laid out with this end in view—that is, using the electric current for medium high-temperature heating, lighting and power, while for low-temperature heating, such as warming the rooms, etc., the steam from the engine exhaust is used. The engine in the power house is of about 125-hp capacity at a steam pressure of 80 pounds, and has a cylinder of 30 by 14 inches, oper-

ating at about 125 r.p.m. It is belted by a 14-inch belt to a jack-shaft, operating at 320 r.p.m., which in turn is belted to a 60-kw Walker compound-wound multipolar generator. The machine is of the internally directed four-pole type and has four brushes. At 800 r.p.m., which is the speed at which it is operated, it generates 125 volts, the voltage of the entire electric system. Another similar generator will also be placed in the engine-room, but has not as yet been installed.

The leads from the dynamo are brought to the switchboard, where the current is controlled by a main switch connecting the dynamo with the bus-bars of the board, from which the feeder cir-

SEWING ROOM.

cuits are tapped through four switches controlling five circuits. Two of these from one switch are for lighting, one for heating and two for power. The board is also equipped with a Carpenter enamel field rheostat, one voltmeter and voltmeter switch, an ammeter in the heating circuit, and a total load ammeter. All wires from the board go to the main building through a short tunnel, and are supported therein on insulators. The wiring throughout the building is all open work, fastened to porcelain insulators, rubber insulated wire being used. Where the feeders enter the main building they divide, going through the various sections of the building. The heating feeder extends to the second floor, where it is divided into several mains and sub-mains, extending to the third floor, where the heating apparatus is located. All

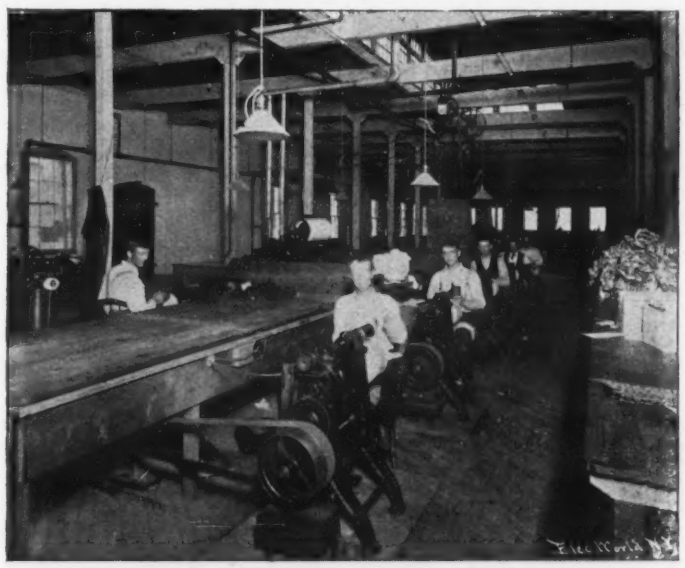
DRYING ROOM.

the various sub-mains or branches are tapped from the second floor ceiling through cut-out boxes, and extend through the floor to the ironing tables and ironing machines above. The lighting feeder extends vertically upward through the building and is tapped at each floor through a fuse switch, thence extended to a distributing cut-out panel on each floor, from which the branches ramify to the various lights. There are approximately five hundred 16-cp incandescent lamps used throughout the factory. All of these are drop cord pendants. The power circuit is branched at various points to cut-outs, each main and submain extending to the particular section to be supplied with power. All departments of the factory are connected by an intercommunicating telephone system with the office, and a Howard watchman's time-detector also forms part of the electrical equipment. The power equipment consists at present of eight motors, distributed throughout the factory, with an aggregate capacity of nearly 50 horse-power. These motors are all of the bi-polar horseshoe type, built by the E. G. Bernard Company. They are distributed about as follows: Elevator 9 horse-power, sewing machines, five motors, three of 4 horse-power and two of 6 horse-power; starching machinery, 6 horse-power; ironing machinery, one motor of 6 horse-power. The 6-hp motors operate at 1500 r.p.m. and the 4 horse-power at 1700 r.p.m.

An exceedingly interesting sight is presented by the sewing room in which are located ten long tables fitted with sewing machines, power-operated from a transmission shaft on each table.

IRONING TABLES WITH ELECTRIC SAD-IRONS.

Each of these tables contains about 30 machines, making an aggregate of nearly 300 machines. The sewing output of this entire equipment is enormous. The tables are set side by side and the motors are arranged in tandem along the wall, with the switching and starting boxes on the side of the wall opposite the motors. A power sub-main runs along the wall and each of the motors is tapped therefrom through cut-out switches. The motor regulating boxes are all of the automatic release type. Each motor operates



ELECTRIC COLLAR AND CUFF IRONING MACHINES.

two tables, it being first belted to a countershaft and thence to the transmission shaft of each of the two tables. The capacity of this entire sewing-machine equipment is about 7500 yards of goods daily, which are made up into various waists, shirts, etc., and hundreds, and in fact thousands of miles of thread are daily sewn into these garments. After the garment has been put together in the sewing room, it is starched by hand and also by starching machinery operated by an electric motor on the floor above. From the starch department the product is taken to the drying room adjacent, where it is thoroughly dried in large hot-air drying compartments. The drying compartment has a capacity of approximately 300 dozen garments, which take about one hour to dry. The heating system for the drying room consists of steam coils with forced air circulation.

The ironing section, which is probably of the greatest interest, is

at the other end of the third floor, and includes six electrically heated collar and cuff ironing machines, which are operated by a 6-hp electric motor, and also two long tables each equipped with 40 electrically heated hand sad-irons of an improved type, making an aggregate of 80 electrically heated irons. By far the greater part of the work, in fact,, nearly all the work under ordinary conditions, both hand and power, is done with electric heat. This is particularly notable and there is no question but that this plant embodies the largest electric heating application for this, or in fact for any commercial manufacturing purpose. When in complete operation the heating apparatus utilizes constantly about 20,000 watts.

Starching Room.

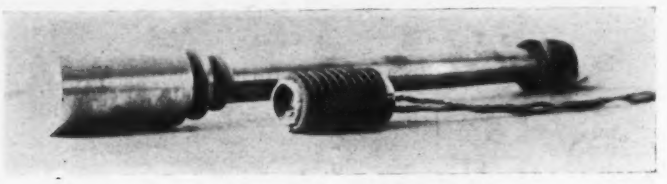
The equipment of each of the long sad-iron tables is interesting. A sub-main from the heating circuit on the second floor beneath extends upward to the centre of each of the tables, which are about 60 feet long, and run longitudinally on the under side of each table in moulding. In the centre of the tables, running the entire length is a series of wooden posts, about 4 inches square and located about every four feet. Directly beneath the posts, the sub-main is tapped by two branches which are run upward on opposite front sides of each post and terminate each in a single porcelain fuse plug box. The irons are of special design, consisting of a cast-iron body and handle, the heating wires being placed inside of the body through a detachable opening on the top. Each iron takes about 3½ amperes at 125 volts. The terminals of the heating conductor come through the front of each iron, being flexibly supported by a spiral

Electric Sad-Iron.

spring, and extend in the form of a duplex flexible conducting cord to the plug of the receptacle. A spiral spring supports this bracket on the top of each post. The plugs are inserted or pulled out of the porcelain fuse plug box as the irons are to be used or discontinued, and no other switching devices are provided.

The collar and cuff power ironing machines mark an innovation in commercial electric heating appliances. These machines in general appearance are similar to the ordinary gas apparatus. They consist of a stand forming two side uprights. A lower main shaft is belted to a countershaft running along the work table adjacent to the machines. This power shaft is operated by the previously mentioned 6-hp motor. The main shaft of the ironing machine has a tight and loose pulley and is geared to two spindles, the upper of which is hollow and carries at one end a rotating smoothly finished iron heating roll, three inches in diameter and about seven inches long, which presses on the large pad roll fastened to the rotating shaft immediately beneath. The heating roll is heated by means of internal heating conductors and the wires from the heating conductor are brought through the hollow shaft to two terminal rings to which the current is fed by brushes. The brushes of each machine are connected by a flexible conductor and plug to a fused porcelain terminal plug on the side of the work table. Two circuits supply the heating machines, the wire being run in moulding on the side of the work table. The collars and cuffs to be ironed are inserted between the heating roll and the pad roll. After the goods are ironed they are examined and packed.

The construction of the heating conductor in both the collar



Electric Heating Roll.

and cuff machine heating roll and the sad-iron is exceedingly simple. In designing this apparatus the intent has been to have all the heating parts simple and durable, and to make and place the heating conductor so that it can be easily replaced. The sad-iron is heated by a slug, which slips into it through the detachable cover on top. The slug is arranged to have a uniform distribution of heat over its surface by a disposition of tapering coils. The roll of the collar and cuff machine is heated by a coiled spiral spring of resistance wire, expanded around an inner mandrel against an enameled inner surface of the outer roll.

It is to be noted that this is practically the first plant combining electric lighting, heating and power, on a large scale and for such purposes, and which has been particularly designed with a view towards electric heating. Mr. C. J. Goldmark was the consulting electrical engineer on the entire plant, while Mr. W. S. Hadaway, Jr., in conjunction with him, designed and supervised the electric heating system machines and appliances. It was calculated by the engineers and guaranteed that the operation would exceed in efficiency the ordinary methods by gas-heating apparatus, and this seems to have been practically accomplished. Complete tests are now in progress.

Eventually it is intended to extend the electrical equipment by the addition of other heating appliances, entirely displacing all other methods. The electric wiring and equipment were installed by Wendell & MacDuffie.

Connections of Railway Generators.

BY J. E. WOODBRIDGE.

In spite of much that has been said on the subject, railway engineers still attempt to adjust the relative compounding of their generators by changing the adjustable shunts on their series fields. Almost every second man in charge of such work has now discovered that this method very often does not suffice, and that it is necessary in such cases to vary the length of the leads from machine to switchboard to obtain a proper parallel working.

This is the more remarkable as railway engineers, of all electricians, should know the different effects of a shunt on series and multiple systems. Possibly the very name "series field" has aided the misunderstanding. The fact seems to be forgotten that each series field is in shunt with all the other series fields, and a shunt across any series field is a shunt across them all.

In Fig. 1 is shown a diagram of three series fields connected, as usual, in multiple between the equalizing main and the terminal bus-bar. This equalizer and bus-bar and their connections to the dynamos are supposed to have, and should have, a resistance which is small in comparison with the resistance of the series fields themselves. Under such circumstances a shunt on field *B*, as shown, obviously acts to shunt current from fields *A* and *C* also. If the dynamo-switchboard connections have a resistance negligibly small

as compared with the series field resistances, a shunt applied to field *B* is just as much a shunt to fields *A* and *C* as to field *B*.

What railway engineer would attempt to regulate a car motor by applying a shunt in the car between the trolley and ground? He could undoubtedly succeed by that method under certain circumstances, but he would also be regulating all the other motors on the same lines.

Unfortunately the equalizing and positive terminal connections in most stations are not of a negligible resistance, so that very often this incorrect method of adjusting the compounding attains its object by the aid of faulty circumstances. It is plain that if the resistance of the switchboard leads from machines *A*, *B* and *C*, Fig. 1, be considerable, then the shunt on machine *B* will not affect the series coils of machines *A* and *C* as much as it will that of machine *B*. The resistance of these leads is necessarily so small that a variation of one ten-thousandth of an ohm, or less in the case of very large machines, is sufficient to disturb the working. The burring of the switch blades is often sufficient to cause this change.

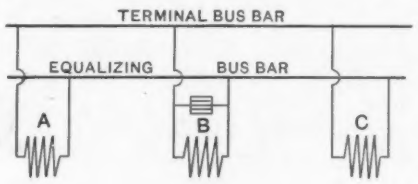


Fig. 1.

There would be many advantages if switches could be left out of these leads altogether, and this could be accomplished by a method similar to the way in which the Edison machines are used in railway work.

Let the series field be connected in the grounded end of the machine. Let the ground returns run straight to the machines clear of the switchboard and pass straight from machine to machine. Let the equalizing main be run in the same way direct from dynamo to dynamo, as shown in Fig. 2, without switches of any kind. Then the positive terminal alone would run to the switchboard. The advantage in simplifying and cheapening the switchboard is obvious. There would be one polarity on the board, which would eliminate the liability of shocks, burning, short circuits, and the sudden annihilation of small tools which occurs with the present bare bus-bars in close proximity, and differing five hundred volts in potential.

There would be but one single pole, single throw switch on each dynamo panel, with one cut out, an ammeter and a field rheostat. This diminished complexity would tend to diminish errors on the part of attendants.

The other compounding of the station would be uniform, regardless of the number of machines in use. On the present system the over-compounding is just as great with one generator loaded as with the whole station loaded; and when the load of one generator is divided between two, the over-compounding falls off fifty per cent.

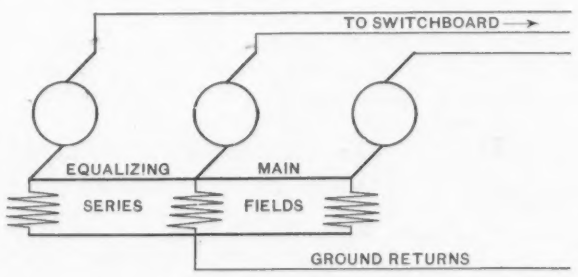


Fig. 2.

With the plan here described all the series fields would be in circuit all the time, and the over-compounding would be independent of the number of machines in use.

With the present system, when a fresh machine is switched in, the series field of the fresh machine takes its share of the current from the other series fields, reducing the voltage of the other machines and increasing its own. When the switch is opened the self induction of the series field causes considerable sparking at the contacts.

With the system proposed the machines would switch together exactly as shunt machines do, without the slightest disturbance of the bus-bar voltage. There should also be a slight economy due to the saving of two-thirds of the energy now used in the heating of dynamo leads, switches, bus-bars and switchboard connections. This would amount to several kilowatts in large stations.

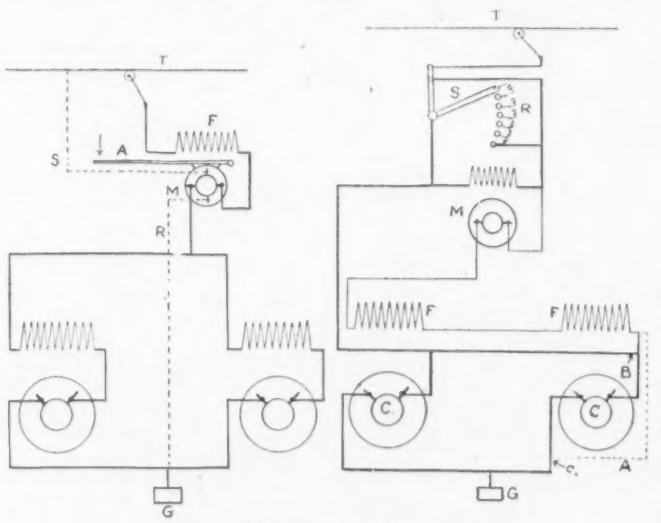
The only disadvantage apparent in the arrangement described here is the fact that the machines, when out of service, are "alive." As the only live points, however, are the grounded terminal and the equalizer, which is always within five volts of ground, it is hard to see what harm could come from this condition.

Controlling the Speed of Car Motors.—II.

BY WM. BAXTER, JR.

In an article on "Shunt Motors," by the writer, which was published in The Electrical World of Dec. 12, 1896, it was shown that with this type of machine, regulation of the velocity could be made very perfect by commutating the shunt field. Equally good results can be obtained with a simple shunt, if the resistance of the coil and the size of the wire are made such as to give a strength of field sufficient to cut the speed down to the lowest limit, when all the regulating resistance is cut out of the field circuit; but this method would not be as efficient as the former for reasons so obvious as to not require mentioning. By either means a perfect gradation of speed could be obtained over the range of velocities requiring such gradations in actual practice. These two examples alone would serve to show that close regulation is possible, and without resorting to any very serious complication; but the shunt coils are not generally regarded as sufficiently substantial to withstand successfully the rough usage to which car motors are subjected, therefore it is desirable to show other ways in which the end may be attained.

Fig. 2 shows an arrangement in which a motor is introduced in the circuit to cut down the E. M. F. delivered to the car motors. It can be made to operate in two ways, one, which would afford the greatest simplicity, would be to provide a brake to absorb the energy. This would be a very inefficient plan, and, so far as the waste of power is concerned, is equivalent to the rheostat system operating in the manner assumed by those who have not had practical experience with railway work. It would be better than such a system, because there would be no danger of burning out. The best arrangement, however, would be to wind the armature with two circuits, the second circuit acting as a generator and returning a current to the line, the energy of which would be less than that absorbed in the motor end, by an amount equal to the loss in conversion. In the figure, *T* represents the trolley line and *G* the ground. The car motors are shown at the lower end of the diagram, connected in parallel with each other. The regulating motor armature as shown at *M* and *A* represents a brake lever, to indicate the manner of increasing the counter E. M. F. by the application of an external mechanical resistance. The lines *S* and *R* indicate the connections between the generator end of the armature and the line, in the construction in which the energy of the motor is used to develop a current by means of which the energy that would be lost if the brake were used may be returned to the circuit. With this last arrangement, the effect of the regulating motor would be varied by changing the magnetizing force around its field, either by cutting out portions of the coil *F* in succession,



Figs. 2 and 3.

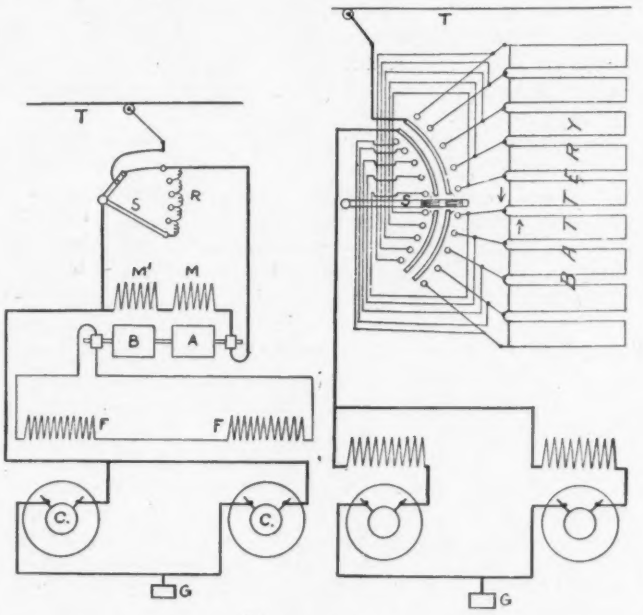
or by shunting the current around it. As will be seen the circuit of the generator end of the armature would be across the line, and in parallel with the car motors; the arrangement, therefore, is simply a means whereby a part of the energy in the car motor circuit, between the trolley line and ground, is transferred to a separate circuit, thus leaving less energy for the car motors, and consequently reducing the velocity. At a first glance this arrangement would appear to be very simple, as well as efficient, since it can easily be seen that by making the motor generator *M* of high efficiency, the energy returned to the line through the circuit *SR* would be but little less than that absorbed by the apparatus in the working circuit, and the regulation of the amount would be effected by simply varying the ampere-turns in the field *F* which could be accomplished by a switch devoid of complication. On further investigating the case, however, we will find that it is not as free from objections as it appears. The first point that will become evident will be that if the armature of motor *M* should come to a state of rest, the current in the main circuit would pass through the path *SR*, resulting in a loss of energy that would be very serious if the resistance were sufficiently low. We will also be able to see that when the armature just begins to revolve, the counter E. M. F. in the generator circuit *SR* will not be enough to balance the line E. M. F., and that this condition will obtain until a certain speed is reached; therefore, it will be necessary to provide means for maintaining this circuit open so long as the velocity is below that required to generate a current of sufficiently high E. M. F. to pass into the line. This defect, of itself, could be easily remedied by providing a cut-out switch of simple construction, but when the generator circuit is opened, the armature of *M* will greatly increase its velocity, owing to the fact that the resistance to rotation will be nearly all removed. This sudden increase in velocity would mean a corresponding increase in counter E. M. F., and hence a sudden reduction in the strength of current through the motors *CC*; consequently a disturbance of the car velocity. This difficulty can be overcome by providing means to counteract the effect caused by the sudden removal of resistance to rotation.

All the objections cited in the foregoing against the arrangement shown in Fig. 2 can be overcome, but only by the use of devices of a more or less complicated character; therefore, when the system is reduced to a practically operative form, it becomes decidedly more complicated than would appear from the diagram. The motor generator *M*, in order to be able to transfer any considerable portion of the energy to the circuit *SR*, would have to be made of large capacity, but, as it could run at a high velocity, its size could be comparatively small. The size, although something of an objection, would not be a serious one in a motor car of sufficient capacity to draw a train of average weight, as there would be no scarcity of space in which to locate it, and no objection on account of the extra weight, as this much, and probably more, would be required to enable the adhesion of the wheels to utilize the whole of the pulling force of the motors.

In Fig. 3 an arrangement is shown which is a modification of Fig. 2, when the latter is used with a brake to absorb the energy of the regulating motor. The difference between the two arrangements is that in Fig. 2 the motor is placed in the main circuit, and therefore the energy dissipated can become even more than that utilized, a condition that would be reached every time the counter E. M. F. of *M* became greater than that of the car motors, but in Fig. 3 the regulating motor is placed in the field circuit only, and hence the most that can be lost in it will be, under any circumstances, less than the energy maximum required to maintain the field magnetism. In Fig. 2 the motor *M*, with a brake to absorb the energy, is equivalent to a rheostat placed in the main circuit of the car motors, and in Fig. 3 it is equivalent to a rheostat placed in the field circuit. As the energy in the field circuit is but a fraction of that in the whole car circuit, the power developed by the regulating motor in Fig. 3 will be so small as not to require a brake to absorb it, the difference in the armature velocity being sufficient for the purpose. The fields *F* of the car motors *CC* are in the same circuit with the armature of the regulating motor *M*. This circuit may terminate by a junction with the main circuit at the point *B*, or it may form a shunt around the armatures of the car motors, as indicated by the dotted line *A*, which taps the armature circuit at *C*. The latter arrangement would not be as desirable as the former owing to the fact that the coils *FF* would have to be of high resistance, and the armature of motor *M* would be required to develop a high E. M. F. and therefore be wound with many turns of fine wire. If the field circuit terminates at *B*, the resistance of the field coils could be made anything desired, by simply proportioning the E. M. F. of *M* accordingly. Hence, the current strength and consequently the size of wire could be made as large as it would be if traversed by the whole current. In any case, the energy developed by the armature of motor *M* would be the same, and would necessarily be but a fraction of that developed by the car motor armatures.

To regulate the amount of energy in the circuit of the armature of motor *M*, all that would be necessary would be to vary the strength of its magnetic field, which could be done in several ways, one of which is to shunt the current around it through a resistance variable by the movement of a switch, as shown by *S* and *R* in the figure. If all the resistance *R* were left in the circuit, the current through the field coils of motor *M* would be the maximum, and consequently the E. M. F. of the armature the greatest.

By properly proportioning the resistance of the field coils *FF* the system can be made to act by having the armature of *M* either help, or oppose, the main current. If the main current is to be opposed, the resistance would be such that when the reaction of *M* is the lowest, the current through *FF* will be the greatest and the speed of the car motors the lowest. With all the rheostat *R* in service, the field of *M* being the strongest, the reaction of its armature would be the greatest, hence the current through the field coils *FF* the smallest and the speed of the car motors the greatest. With all the rheostat *R* out of service, the current through the field of *M* would be the minimum, and, hence, the reaction of the armature



FIGS. 4 AND 5.

little or nothing, thus allowing the maximum current to flow through the coils *FF*. From the foregoing it can be seen that the speed of the car would be controlled by simply moving the switch *S*.

The advantages of this arrangement over the one shown in Fig. 2 are that the motor *M* would be very much smaller, and the loss of energy as much less as the difference in the size of the motors. This comparison would be true upon the assumption that in Fig. 2 the energy of the regulating motor is absorbed by a brake, but if it is returned to the circuit by adding to the armature a generating circuit, the loss in both cases would be about the same, and then the only advantage of Fig. 3 method would be its greater simplicity. If the frictional resistance of the armature of the regulating motor is not enough to balance the energy developed, additional resistance can be easily obtained by placing a small fan upon the end of the shaft.

To arrange the system so that the armature may help the current, all that is necessary is to make the resistance of the coils *FF* so high that when the armature is not rotating the minimum current will flow through them; then when the E. M. F. of the armature is added to that derived from the main circuit the current will be increased. In this case the action will be just the reverse of what it was in the previous arrangement, but the effect upon the regulation of the speed of the car motors will be the same.

Fig. 4 is another arrangement for obtaining graduations of velocity by means of an auxiliary motor. It differs from the other two in

that the current for magnetizing the car-motor fields is a secondary one, entirely independent of the main current. As will be seen, a rotary converter is used in place of the motor of Fig. 3, *A* being the motor armature, and *B* the generator armature. The construction of this transformer can be varied as much as desired, so long as it is so made that it will generate a current that can be varied by the movement of the switch *S* or an equivalent device. In the diagram the field coils, M^1M, of the motor and the generator armatures, *AB*, are both in series and in parallel with the rheostat, *R*, therefore the movement of the switch, *S*, will affect the strength of both fields. The result of this is to reduce the energy developed by the motor end, and at the same time to lower the inductive action of the generator armature; hence, a smaller variation in velocity will be required to give any desired change in the E. M. F. of the circuit containing the field coils, *FF*, than would be the case if only one of the coils, M^1M, were in parallel with the rheostat, *R*. It does not follow, however, that this arrangement would give the best results, for, if the coil, M^1, were not in parallel with the rheostat, and only *M* were affected by the movement of the switch, *S*, the variation of the field of armature, *A*, would be twice as great, and, therefore, although the generator field would remain unchanged, the reduction in the energy of armature, *A*, would result in a corresponding reduction in the velocity; hence, the net result, in either case, would be about the same.

In the diagram the motor and the generator armatures are shown separate, as it more clearly illustrates the operation of the system than the representation by a single armature, as in Fig. 2. It is needless to say, however, that the same design would answer for both cases, the only difference being in the size.

The three plans shown in Figs. 2, 3, and 4 are of such a character that they can be made practically successful without difficulty, with the single exception of the modification of Fig. 2, in which the energy of the motor is balanced by a brake, and even this would be admissible if the inefficiency were not regarded as an objection. The advantage of Figs. 3 and 4 over Fig. 2 is that, as in these, only the field current is regulated, the size of the regulating motor, or transformer, can be very much reduced; but to offset this, it must be said that the range of variation in car speed is not so great, as it can only be from the lowest speed obtainable when all the field strength is utilized, up to that developed when the current in the field coils is so small that the armature will so far predominate, as to cause the brushes to spark to an inadmissible extent. With the arrangement shown in Fig. 2, the speed can be varied over a much wider range, and can without difficulty be made to start from a point where the wheels of the car would just turn. Another advantage is that no matter how much the velocity may be effected, the relation between the armature and the field of the car motors will remain unchanged, since the regulating device is in series with the whole motor, and not a part; hence, there would be no more tendency to spark at one velocity than at any other. This advantage is believed to be a very important one by some engineers, but it is really of less moment than they believe, as can be seen from a consideration of the actual conditions under which the field strength is reduced, in cases like those shown in Figs. 3 and 4, where the velocity is regulated by varying the strength of field, the armature remaining subject to the entire E. M. F. of the operating current at all times.

In the process of reasoning by which it is concluded that a reduction of the field strength will cause excessive sparking, it is assumed that the armature current can increase indefinitely while the flux through the field is reducing in a like manner. As the velocity increases in a similar manner, by carrying this reasoning to its ultimate limit, we will find that when the flux becomes zero, the velocity will be infinite, and so will the armature current. This would all be true, if the armature had no work to do, and could rotate theoretically frictionless, but it would not be true under any other conditions. The torque is proportional to the flux into the ampere-turns, and as when the former becomes zero, this product will become zero, the rotating force will also become zero, hence, the condition can never be reached. Now a proper consideration of the case will show that in practice no condition of field strength can be obtained that does not correspond to the torque required at the velocity prevailing at the time, as well as with the armature current. We cannot assume this torque to be anything we please, but must make it correspond with the actual resistance opposing the motion of the car. It is possible to obtain a given torque at a given velocity, by any combination of field strength and armature current strength within certain limits that will yield the same product; hence, with different styles of winding, as with series, and shunt, for example, it is possible to obtain wide variations in the relation between the strength of field and the armature current, and therefore a considerable difference in armature reaction, enough to make the brushes run sparkless in one case and just the contrary in the other. It is also possible with any style of winding, to so proportion the various parts that the field strength and the armature current will be the same for the same speed and torque as they are with a plain series winding; hence, if the brushes will not spark on a series wound motor when running at any speed on a given track, they will not spark with a variable shunt wound motor making the same velocity on the same track, because in both cases the armature current and the field strength would be the same, if both motors were operated by a current of the same E. M. F. The current through the armature should be slightly less for the shunt machine, since the difference of potential between the brushes would be higher. This would necessarily be the case unless there were a difference in efficiency, therefore, if there is any difference in sparking, it should be in favor of the shunt motor.

The only way in which the armature reaction can be made greater in a motor in which regulation is effected by variations in strength of field, is by making the torque greater at any given speed than it would be with a plain series motor, and this can be done if the regulating device is not provided with safeguards to prevent it; but as such safeguards can be provided, this possibility need not be considered.

In the foregoing the variable shunt winding is taken as the representative of the various arrangements for regulating the speed of the car by varying the strength of the field, and the statements made are only true in relation to such systems. They would not be true for a plain shunt, because in such a winding there is not variation in field strength.

With series wound motors there is but one torque corresponding to any given strength of current, and only one speed at which this torque is given, except in the case of series-parallel control, in which two speeds are obtainable and the commutated field system in which the number will be in proportion to the number of combinations of the field coils that produce a change in the ampere-turns. With the methods of control here discussed, a given torque can be obtained over a wide range of velocities, but as it is not necessary to make this range very great, and as doing so would produce the destructive sparking that the friends of the steam locomotive claim would be the inevitable result, arising from the use of such a system in any form, it would be necessary to provide means to limit the variations in velocity. If a plain series motor would run at say 50 miles per hour with a given torque, the variable field method might be made to give the same torque at any speed from forty-five to fifty-five miles. It might be claimed that this would not be satisfactory in practice, because if motors that would give a horizontal effort of say 10,000 pounds, at a speed of thirty miles per hour, were used to run a train requiring such an effort at sixty miles they would fail to meet the requirements; but this is about equivalent to saying that a locomotive that could draw a train weighing 300 tons at thirty miles would be used to draw the same train at sixty miles. It would not be used for such work, simply because it would be incapable of performing it. But it would not be regarded as a failure on account of not being able to work beyond its capacity; and what is true of steam is true of the electric motor, and an equipment designed to develop a given effort at thirty miles per hour would not be used to do work requiring the same effort at sixty miles.

The Canadian Electrical Association.

The final arrangements for the convention of the Canadian Electrical Association, at Niagara Falls, Ont., June 2, 3 and 4, have been announced in part. The sessions of the convention will he held in the Assembly Hall of the Dufferin Café, in Queen Victoria Park, where the annual association banquet will also be given on the evening of the second day. The Hotel Lafayette will be the headquarters of the association.

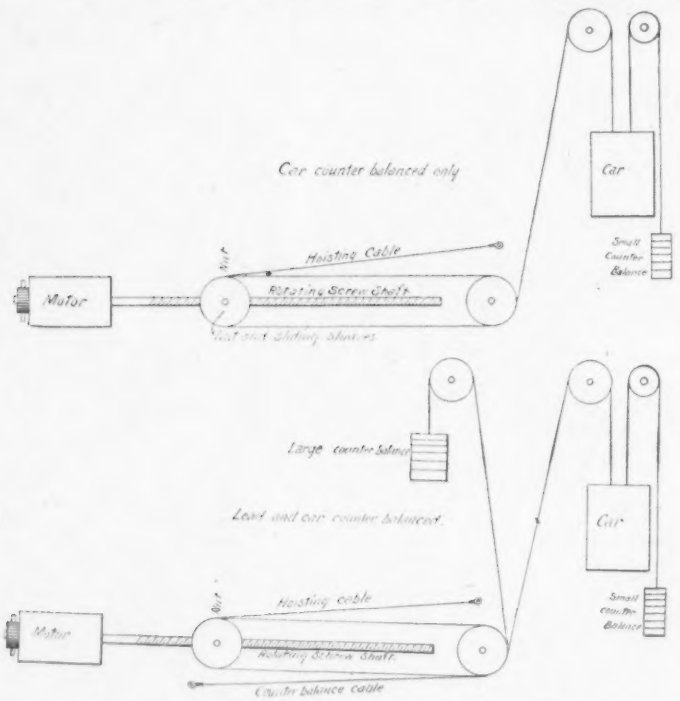
Paris Exhibition of 1900.

The French journals announce that the well-known electrical engineer and writer, Mr. R. V. Picou, has been appointed chief electrical engineer of the exhibition of 1900. Charles Bourdon has been appointed the chief mechanical engineer.

Electric Elevators.—III.

When the motor stops there is nothing to hold the car excepting the friction of the gearing, which in some cases may be entirely overcome by the weight of the car or counter-balance and the driving action reversed. Therefore, it is absolutely essential to provide an extremely efficient braking apparatus in machines of this class, the function of which should be to securely hold the car in stopping, preferably by griping the motor shaft. Brakes for this purpose, as usually constructed, are either of the band or shoe type and are operated by electromagnetic devices or mechanically by the operating mechanism in conjunction with the controlling apparatus of the motor. In either case the operation of the brake must be adjusted to work properly in conjunction with the motor controlling apparatus. Usually the brake is lifted just a little before the motor starts and applied immediately after the current is discontinued. If the proper adjustment does not exist trouble may occur through excess of current taken by the motor under such heavily loaded conditions.

Electric brakes are ordinarily arranged so that the electro-magnet or solenoid raises the brake instead of applying it. This is a great advantage, because any rupture or failure of the current supply, de-energizing the motor, would automatically apply the brake and prevent any tendency of the car to move uncontrolled by the motor. With the brake applied mechanically by the operating rope



Screw and Sliding-Nut Electric Elevators.

or cable, the car if heavily loaded may reverse the driving action under such conditions and drop unless the clutches or the mechanical appliance in the car are operated. Sometimes both forms of braking devices are combined. The electromagnetic apparatus releasing the brake is usually arranged to be energized when the main switch is operated. Dynamic braking, by using the motor as a dynamo where the car is allowed to descend by gravity, may be resorted to, but a friction brake of some kind must also be provided to hold the car at fixed points in the shaft. It is entirely inadvisable to control the speed to any extent whatsoever by the braking appliances; their function should simply be to hold the car in stopping. In connection with the danger element due to the rupturing of the circuit or current supply, the use of automatic protective circuit-breaking devices, either fusible or magnetic, should be mentioned. Their use offers great opportunity for the above conditions and therefore great care should be exercised in arranging the point of action of such devices. This point should be brought to a maximum, the motor being allowed to carry as large a current as possible without destruction before such circuit brakes operate. They should preferably protect the motor and not the line, which should be of ample capacity.

The speed at which elevators for various purposes operate is about as follows: For freight and very low passenger duty, 50 to 100 feet per minute; for ordinary medium passenger service, 150 to 400 feet per minute. In the latest types, for high speed service, this speed is exceeded, and brought to 500 feet and over per minute. In regard to the speed of operation two methods are available, one in which the speed of the car is invariable and the other in which the motor speed and consequently the car speed may be varied. The latter method may be secured by the direct mechanical control of the motor starting switch and rheostat, or by the indirect electrical method, and it may also be obtained by the voltage variation method. The automatic starter arrangement only gives one working speed. The variable speed has its advantages, particularly where it is desired to stop in a short distance, at exact points, or to make certain repairs. A fixed speed, however, with quick stopping devices, is almost equally satisfactory, with probably the greater simplicity of apparatus for ordinary conditions.

The inherent features of the two types of direct-connected elevators may be discussed here. The drum machine reduces high speed in the motor to a comparatively low rotative speed, but really high peripheral speed on the drum, usually by means of a screw and worm gearing. Spur gearing does not seem to give satisfactory results for this purpose for reasons previously mentioned. The efficiency of this transformation from the motor to the rope on the drum is about 50 to 60 per cent. with the ordinary single worm gearing arrangement. Modifications of this arrangement, where an interlocking system of gears is used, give 10 to 15 per cent. higher efficiency. The drum machine, especially when used for high lifts, has a shifting cable lead on the drum, and for high speeds and lifts the drum is usually very large in diameter. Multiplying sheave devices in the hoist cables do not seem to have been used as yet in connection with drum machines, but their use would certainly seem to improve the last named condition. It is to be noted, however, that this type of elevator, as ordinarily built, has no absolute positive stop of cable travel.

While the drum machine is being manufactured in great variety only one concern is developing screw and sliding nut machines at the present time, although several machines of this type, aside from this particular variety, were shown at the late World's Fair. The screw shaft is usually placed horizontally and the high speed rotary movement of the motor is transformed to a low speed reciprocating movement in the nut, which is again transformed to a high speed movement in the car end of the hoist cable. Vertically placed machines of this type have lately been developed. The efficiency of such machines depends greatly upon the construction of the nut, and if this is of the ordinary type in direct contact with the screw, the efficiency would be very low.

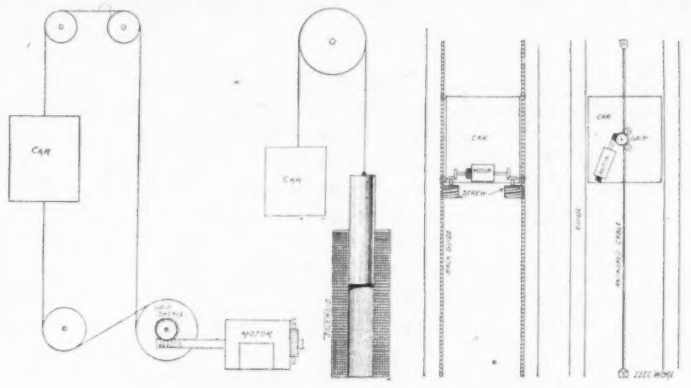
By a peculiarly constructed nut it is claimed that the efficiency has been raised to about 65 to 70 per cent., including all transformations from the motor shaft to the car end of the cable. One special advantage claimed for this type of machine is that the cable lead is absolutely fixed and there is a positive limit of travel.

One particularly distinctive feature is the over counter-balancing, which is practically possible with the drum machine only. Taking for instance the ordinary passenger elevator car which weighs probably 1500 to 1800 pounds and its load weighing perhaps 2000 pounds, it is possible not only to counterbalance the weight of the car, but practice has shown that over counter-balancing about one-third to one-half of the load carried by the car, in addition to the car counter-balance, gives the most economical results.

The weight moved by the motor is the difference between that on the car cable and the counter-balance weight. As this may be in favor of one or the other, according to the load on the car, it is necessary to operate the motor in both hoisting and lowering. It will readily be seen that when the two are equally balanced the motor develops the minimum of energy; in fact, only enough to move the machinery. Over counter-balancing decreases the necessary motor capacity, and it will readily be seen that the minimum required motor capacity will be reached when the system is over counter-balanced 50 per cent. of the maximum load on the car. This does not necessarily give the most economical results in operating, unless the conditions approximate that percentage of the full load in going up or down. The nearer the load comes to the counter-balance the less energy is required. Various methods are adopted to counter-balance the load and car. The over counter-balance weight may be hung on a cable wound oppositely to the car cable on the hoisting drum or part may be directly hung from the car and part from the drum. In this last-mentioned method the counter-balance from the car must be properly adjusted, for if too large, the car cable is apt to slacken. For this reason the screw and nut machine cannot be satisfactorily over counter-bal-

anced, as any large counter-balance attached to either the car or the movable sheave in the ordinary method would slacken the cable. Additional counter-balance sheaves and cables would be needed pulling oppositely to the car cables. A weighted multiplying sheave arrangement co-acting with the car cable may be combined with the drum counter-weight, but in no case should the car counter-weight overbalance the car.

The operation of the motor in hoisting only is one of the earliest ideas connected with the electric elevators and could be applied to drum machines as well as the screw type of elevators. Even in some of the present drum winding machines, when the car is heavily loaded, it tends to operate the motor as a dynamo, when descending equalizing or even overcoming the pressure at its terminals and thus feeding current to the line or other machines which may be operated in bank arrangement therewith. This is only possible with a motor and gearing of high efficiency, unless the car is overloaded and the descending speed far exceeds the normal, which should never occur if



VARIOUS FORMS OF ELECTRIC ELEVATORS.

the speed devices work properly. The motor should preferably be shunt wound, on the down trip, otherwise this action may be reversed. An excellent result would no doubt be obtained by using a battery across the line and allowing this current to be stored therein. The use of the storage battery, as has been previously stated, presents other advantages in addition. The starting current required by a motor service which is connected to a general supply system should be as even as possible in order to cause the minimum variation in drop in the supply mains. Elevator service itself is quite inconstant, and therefore the starting and operating currents should be reduced to a minimum. This result can only be obtained with over counter-balanced machines, the motor working in both directions, and by the proper arrangement and adjustment of the controlling devices. Where the motor hoists only, the starting and operating current must necessarily be greatly in excess of that in the over counter-balanced machines, but while this type of machine may consume twice the current in raising, it uses none whatever in lowering, and therefore the starting and operating current is entirely eliminated during this part of the operation. The banking of a number of machines using a large starting current or in which the motors operate in hoisting only, equalizes the work on the line more or less and in that way the aggregate demand is evened.

In comparing electric elevators with other types, the exceedingly great flexibility of the electric machine is particularly to be noted. Such machines are entirely self-contained, and may be located at almost any point in the hoistway. The current supply from central stations, which has become almost universal in our large cities, makes it possible to install such elevators in many instances where it would otherwise be impossible to place an elevator, because often the conditions would not warrant the installation of an isolated power plant, whether for hydraulic or electric service. This is particularly the case in small buildings and residences.

The operation of electric elevators from isolated electric power plants presents, however, the greatest advantages. Most large buildings are at the present time equipped with isolated electric lighting plants and the economy of such installations can scarcely be doubted. If properly designed, the generating plant, possibly including a storage battery, can be combined for both lighting and power service, obviating any necessity for the installation of separate elevator generators, the elevators being directly operated from the lighting supply wires. Certainly such an arrangement necessitates careful adjustment in order to even the fluctuating demands of the elevator service, but will certainly give economical results which can scarcely be approximated by any other service.

The great advantage which the electric machine has over any other, however, is that the energy consumed by the motor is only in proportion to the load carried. It is true that a hydraulic elevator, with which the electric machine is to be more directly compared, takes energy only in one direction, but this energy in ordinary forms of hydraulic machines is always the same without regard to load. The excess energy taken by the hydraulic elevating machine over that which is necessary to lift the load becomes a very large factor, particularly with long lifts. This fact seems to have been quite fully appreciated and in the latest types of high duty hydraulic machines it has been attempted to get results similar to the electric method by varying the amount of energy supplied to the hydraulic cylinder in proportion to the load. Such methods consist of some varying pressure pump or multi-piston arrangement, but are usually complicated. For very high lifts, the latest type of hydraulic machines also employs very high pressures, which introduce another element of uncertainty and accident.

The operation of an elevator plant must primarily depend on the cost of bringing power to the elevating machine. The actual efficiency of both the hydraulic and electric machines may possibly be the same at full loads, but the cost of turning the energy into the electric hoisting machine would seem to be certainly less with a properly designed combined electric lighting and power plant. Altogether, even if at full load the efficiencies in both cases were the same, the aggregate advantages of the electric system far overbalance those of the other and warrant the belief that, in one form or another, it will eventually win the competition even of the highest class of service. Present indications seem to substantiate this.

The various principles here discussed will be further illustrated by the specific types of direct-connected elevators hereafter described.

Financial Practice and Engineering Methods of American Street Railways.

At a meeting of the New York Electrical Society, held at Columbia University on the evening of April 7, Mr. E. E. Higgins gave an informal talk on the methods of engineering practice and finance employed by American railways. In his introductory remarks Mr. Higgins stated that the small section of the country including New England, the Middle States, Ohio, Virginia and West Virginia contains 64 per cent. of the cities of the United States having over 15,000 inhabitants, there being in all 215 such cities. In the section north of Mason and Dixon's Line and west as far as Kansas City, including about one-fourth of the area of the country, there are no less than 83 per cent. of the cities. South of this line there are 11 per cent. and in the great West only 6 per cent. of such cities. Of necessity, this means that the great street railway section of the country is the East. In the Eastern part of the country nearly half of the street railway mileage is concentrated. The East and central East contain over three-fourths of the total mileage of the country, and the capitalization is divided in much the same way. One of the most interesting features in connection with this Eastern field for street railway operations is the fact that the concentration of cities necessarily brings them close together and the opportunities for interurban and suburban roads are very great. For example, the whole eastern part of the State of Massachusetts is a network of electric and steam railways. In the West, where the centres of population are more or less isolated, street railways have to rely upon purely urban traffic, few of the cities having suburban districts to act as feeders for these lines.

Mr. Higgins briefly sketched the history of street railway enterprises. Speaking of the period of rapid growth of street railways, between 1860 and 1870, he said that, of course, in those years all railways of this sort were built to be operated by horses. The first cable road was put in operation in San Francisco in 1872. In the early 80's there was much uneasiness among the street railway companies. The undesirability of horses was conceded, but no new motive power had appeared to take their place. The cable was too expensive for most roads, and only the greatest density of traffic could legitimize the installation of a construction costing anywhere from $75,000 to $300,000 per mile. Compressed-air motors, gas motors, ammonia motors and many other curious forms of self-propelling devices were tried and abandoned, and it was not until

the success of the Richmond installation in 1888 that the possibilities of the new electric method of traction were made evident. In four years electric traction was practically determined upon by all street railway managers. In many cases the cable systems were replaced by electric systems, the mileage of cable roads being actually smaller at the present time than in 1892. The result of the extension of electric railroads during six years is that to-day, out of 15,000 miles of tracks in the United States, 85 per cent. are in operation by electricity as against only 8 per cent. (1200 miles) by horses, and 4 per cent. by the cable system. The balance are operated by miscellaneous motive powers, chiefly steam. Mr. Higgins spoke at length of the comparative value of street railway franchises and charters in various districts. Many of them he considered as of less value than the corresponding charters under which steam railroads operate. The municipal franchises granted within the past few years are of much less value than the earlier ones, with few exceptions. In New York, Pennsylvania and one or two other States the early franchises are practically for perpetual operation. In Illinois a fifteen-year time limit is set for such franchises by a State law and seriously curtails the value of these instruments. Nowadays the average life of a franchise is from thirty to fifty years, and this is having a very serious effect upon the prosperity of street railroads. In Massachusetts, the state of things is even worse; the street railway companies being practically tenants at will of the city and State, their charters are revocable at any time. Speaking of the agitation in the newspapers reparding the payments made by street railways to municipalities, Mr. Higgins thought that many things are lost sight of. It is impossible to generalize on this question of franchises. The burdens upon street railways of this country are as heavy as in any of the cities of Europe. These burdens come in a number of ways other than by direct taxation. When the introduction of electricity made it necessary to tear up the streets, the cities promptly utilized the power they had to impose taxation by obtaining from many companies contracts to pave and keep in repair large portions of the streets through which their lines are operated. A conspicuous example was cited of a company which operates several hundred miles of track in one city, and is compelled to pave and keep in repair perpetually every mile of street, from curb to curb, through which its cars run. Taxes on gross receipts are a common feature of municipal finance. These taxes run anywhere from 3 to 20 per cent. In addition to these, taxes on real estate and personal property are almost always imposed, and in some cities car licenses and taxes on nearly everything that can be made to stand a tax are the common features of street railroads. In addition to all this, where a franchise is granted for a limited term of years, without any statement in the contract as to what is to happen at the end of the period, it really amounts to a tax on the franchise, because a sum has to be laid aside out of the earnings to take care of possible contingencies at the expiration time of the franchise.

The question of the theory of charges on street cars was taken up by Mr. Higgins and comparisons made between the uniform rates in America and the differential rates common in Europe. The operation of the uniform fare rate has had a considerable influence on the growth of our cities, since a passenger can go as far as the street railway line runs for the same fare he would have to pay for a short ride. By the European system of differential rates, there is a tendency to condense population in the hearts of cities, and in many cases the small extra cost of fare between suburban points and thickly-settled districts is sufficient to cause working people to resort to tenement-house life instead of the more desirable separate method of living in less populous neighborhoods. Of course, the operation of the uniform fare means that short-distance riders have to pay a part of the fare of the long-distance riders. There can be no question that the effect of street railway extension and the uniform fare has been an increase of city areas and their assessed valuations, a reduction of taxes and a general improvement in the conditions of living. In comparing English and American cities of the same population, the American cities contain from twice to three times as much mileage of street railways and support a traffic anywhere from two to six times greater than the English cities. Mr. Higgins spoke at some length of the overbuilding of street railways which followed the introduction of electricity as a motive power. At that period franchises were easy to obtain, and an exaggerated idea prevailed as to the profits of street railway operation, and many lines were built for which there was no legitimate reason. This fact is particularly noticeable in the Western cities.

Speaking of schedules, Mr. Higgins stated that the minute you begin to talk about schedules for street railways people begin to walk. They do not want to bother with schedules. If they know they can get a car by waiting five minutes they will do so, otherwise they will probably walk so far that, when the car overtakes them, they will not consider it worth while to ride the rest of the distance they intended to go. The difficulties of transfers furnished a theme for considerable remark. It seems a hard thing for cities to compel street railway companies to put in a transfer system for the benefit of the small portion of the riding public who use them. It means a large reduction in income, because of lost and misused tickets, and the establishment of a force to take care of transfers and check them up to prevent the conductors disposing of them in saloons. These difficulties are hard to explain to residents of a city through the press, and the press itself is often misled about them. Citizens of certain cities see that transfers are being granted in other places and they come home and begin the agitation for transfers in their own towns.

After speaking of car mileage, capitalization and the comparative net earnings of street railway companies, the probable conflict between electric railroads and steam railroads was touched upon. This is more likely to take place in the Eastern section of the country than in any other. There are already established in these States two networks, one of electric lines and the other of steam railway lines, and unless steam railways are more profitable in the future than they have been in the past the conflict is apt to be severe. It was the opinion of the speaker that electricity will shortly be introduced on what are now steam railroads to a great extent in the States of Massachusetts, New York, Pennsylvania, New Jersey, Connecticut and Rhode Island. The solution of the problem which confronts steam railroads in the retention of their local business, which has been a fairly profitable one, lies in the adoption of electricity and the multiplication of stations. The street railway cars traverse highways where there is an ordinary wagon traffic and foot passengers as well, and they are necessarily at a disadvantage in the matter of speed. Speeds possible on such lines would not likely exceed ten or twelve miles an hour, whereas on the steam railroads, with their unobstructed right of way, much higher speeds could be made. It was suggested that the steam railroads might arrange systems of semi-circular lines or half-loops running substantially parallel with their main lines and touching at stations at frequent intervals along the main line. They could then establish branches in the cities that would take passengers to their destinations in a manner similar to that done by the present system of electric railways.

The question of power station is in one sense at the root of the whole problem. In another, it is not, because the cost of power is a small proportion of the whole expense. It would be surprising, and certainly interesting, to make a comparative estimate of the cost of real estate and buildings necessary for operating a horse railroad and an electric railroad plant of the same size. It is likely that the figures for the horse road would be several times those for the electric road.

An illustration of the difference between American and foreign engineering was cited in the curious case of a road in Europe, serving a city of about 175,000 people, which is actually building seven power stations, each having a capacity of about 300 kilowatts, operating some sixty or seventy miles of lines. In this country the idea is concentration. As far as the lines of development are concerned as to the future of the power stations, Mr. Higgins thought that there is little to be expected on present lines. Steam engineering in its present state has been the result of so many years of development and study that we can hardly get above the economy of the engine that we have to-day. The efficiency of the dynamo is so great that little can be expected from its improvement. There are two possibilities of the future which must not be lost sight of, however; one of them is the longed-for direct conversion of coal into electricity, and the other the use of turbines instead of engines. Regarding distribution circuits, there has been little change since the early installations. Much is to be hoped for from the alternating system, which will solve many problems. It is not a pleasant thing to put a whole copper mine in a city, and the alternating system would also solve the troublesome problems of the commutator on the motor. Regarding underground conduits, Mr. Higgins thought that the closed conduit, while a very pretty device from the inventor's point of view, was too complicated and too liable to give trouble to attain practical success. The open-conduit construction now in use here and elsewhere is very nearly perfect, the only disadvantage being its high initial cost. After some general remarks about tracks and rails and rolling stock, Mr. Higgins brought his remarks to a close and received, upon motion of Mr. Nelson W. Perry, a vote of thanks for his admirable address.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Formulas for Transformers. SUMPNER. Lond. *Elec.*, April 2.—A brief communication criticising the correctness of the triangular diagram used by Russell (see *Digest* last week). With ordinary alternating currents the formulas give essentially correct results, but an assumption has been made which is not correct in the general case, which, therefore, renders the method of proof inaccurate; a plain figure cannot be made to represent the true facts, but it may do so with sufficient accuracy for all practical purposes.

Dynamo Steel.—Elek. Zeit., March 25.—A brief communication from Oeking & Co., referring to the tests of their steel recently published by Du Bois and Jones, and stating that the samples were submitted some time ago and are quite different from the material made at present; they add some data obtained by the Reichsanstalt with their present material and compare it with that of Krupp, showing it to be slightly better in the hysteresis loss. Another test made with a piece of the same steel after annealing gave the unexpected result that the hysteresis loss is greater than in the unannealed specimen.

Non-Synchronous Motors. BEHREND. *Elek. Zeit.*, March 25.—An article in which he shows how the calculation of three and single phase motors may be based on the calculation of transformers; it is supplementary to the work of Behn-Eschenburg, Blondel, Heyland, etc.; tests show good agreement between theory and practice.

Dynamos. GAY. *L'Eclairage Elec.*, March 6.—Brief illustrated descriptions of the Atkinson and the Ferranti alternators.

Dead Wire in Armatures. PFUND. *Elec. Eng.*, March 31.—A continuation of the discussion of this subject (see *Digest*, March 6); he admits one error and disagrees partially with Anthony; a further argument is given but it does not admit of being abstracted, and seems somewhat vague.

Commutatorless Dynamos. DE PUYDT and PONCIN. *Elec. Eng.*, April 7.—A brief communication which appears to be the same as the one noticed in the *Digest*, April 10.

Care of Electrical Machinery. BAXTER. *Power*, April.—Practical descriptions of methods of making repairs in the case of burn-outs on field magnet coils.

LIGHTS AND LIGHTING.

The Economy of Incandescent Lamps. WEBER. *Elek. Zeit.*, March 25.—A reprint of a short paper in which he makes a comparison between the incandescent electric and the incandescent gas lights on an entirely different basis than the usual one. Comparing the cost of production of the light, the incandescent gas light is much cheaper, that is, there is more light produced for the same cost, but anyone who is interested in the cause of this difference may look at the matter in a different way; the costs are dependent on two factors, namely, the electric lamp itself with its efficiency, and the other the cost of the current; the efficiency of an incandescent electric light is generally incorrectly estimated; a correct comparison might show where improvement can be looked for; with this in view he finds that in the Welsbach light there are consumed for each candle power 10,800 gr calories per hour, but a 4-watt electric light consumes only 3456, that is in the ratio of three to one, which means that the economy of the incandescent electric 4-watt lamp is three times as great as that of the Welsbach light; the general opinion that the Welsbach light is a very perfect apparatus for converting energy into light is therefore fundamentally wrong; the difference in the cost of running the two lights is therefore not due to the lamps themselves, but only to the fact that the electric current is so much more expensive; improvements in the incandescent electric light, therefore, cannot be looked for to equalize this difference.

High Voltage Lamps and Central Station Practice. ADDENBROOKE. Lond. *Elec* and *Elec. Rev.*, April 2.—A list of stations at present using high voltage lamps (in Great Britain). They are 39 in number using voltages between 200 and 230; he expresses surprise at the very rapid adoption of the high voltage lamp; it confirms his prediction of a year ago; he thinks their use will be almost universal before long.

Arc Lamps for Small Currents.—Zeit. f. Elek., March 15.—A brief illustrated description of the Hansen lamp, which is built for all currents beginning with one ampere and is said to be meeting with great favor.

Enclosed Arc Lamps.—Bul. Soc. Int. des Elec., February.—A reprint in full of the discussion following the paper by Marks, which was recently reprinted in THE ELECTRICAL WORLD.

POWER.

Long Distance Alternating Current Transmission. ESSON. Continued in Lond. *Elec. Eng.*, April 2; begun in Lond. *Elec.* and *Elec. Rev.*, April 2.—The continuation of the reprint of the paper noticed in the *Digest* last week; the paper is general in character and seems to be a summary of the present practice in alternating current transmission; it seems to be well written and by one who is experienced; with the exception of parts, it does not admit of being abstracted. He considers the question of frequency, intimating that 60 is about the proper limit, considering everything; regarding the form of the E. M. F. curve, he concludes that the sine curve is in all respects the most suitable; the construction of the generators is considered at some length with the aid of diagrams; present practice, he states, is not to exceed 5000 to 6000 volts in the generators; the experiment of running at higher pressure for motor work has yet to be made. The line and its construction and protection, are discussed at some length, preference being given to overhead lines; the size of the wire is discussed at some length; assuming the same drop, the same difference of potential between each pair of wires, and the use of the same kind of motors, the single-phase two-wire system would require a weight of copper represented by 1., the two-phase four-wire system by 1., the two-phase three-wire system by 0.85 and the three-phase three-wire system by 0.75. Generators can readily be wound up to 5000 volts; likewise motors of over 100 horse-power; a motor from 75 to 100 horse-power can be wound for 3000 volts, 50 horse-power for 2000 and 25 for 1000; for transmitting power to a group of large motors there is no need to use step-up or step-down transformers until the distance exceeds that at which 3000 to 5000 volts is economical; if the bulk of the energy is to be used for motors of a medium power, it might pay to reduce the line pressure to a suitable figure, using more copper but saving the cost of transformers; if there are so few motors that the whole current must be transformed, there is no use in working the line at less than 3000 volts; this is illustrated by an example in which he calculates the cost under various conditions with and without transformers and including a table of the cost of the line wire to transmit 300 horse-power various distances at various pressures; no general conclusions are drawn except that when the distance approaches ten miles, step-up transformers must be resorted to; the reprint is to be continued. The paper is also discussed editorially in the London *Elec. Rev.* and London *Elec.*; the former states that it reveals the fact that some serious difficulties still attend the working of alternating-current transmission plants; for large powers distributed for over one mile, it is admitted that the polyphase system is worth considering, but below that distance with many of the installations which are to be dealt with in that country, the continuous currents are better, simpler and cheaper; in the discussion, which has not yet been printed, Mr. Siemens expressed his opinion that continuous currents are the best for the transmission of power.

Electricity in Mining. PIERARD. *L'Elec.*, March 13.—A brief description of the plant at the coal mines of Marles in which an electric locomotive weighing 1800 kg is used.

Continuous Current Power Transmission. HECHT. *El'ty*, April 7.—The beginning of a reprint of the article noticed in the *Digest* April 3.

TRACTION.

New Heilmann Locomotive. DROUIN. *L'Elec.*, March 20; translated in abstract with many of the illustrations in the Lond. *Elec. Eng.*, and with one of them in the Lond *Elec.*. April 2.—An article of some length accompanied by a large number of illustrations including a general view and sections of the locomotive and of the separate parts. The data of the first one built in 1893 is given; its power was less than that of the ordinary steam locomotive, but experiments were made from which the following results were obtained: The stability is independent of the velocity and is affected only by the condition of the track; the balancing of the moving parts is perfect. It would at first seem that the double transformation of energy would involve a loss in efficiency, but this is not the case, as in the double transformation, although involving a loss of about 15 per cent., the steam is better utilized; trains of 65 tons were drawn with a consumption of less than 4 kg of coal per km; the efficiency of the steam engine is kept approximately constant. The two new locomotives were then built on the same general plans but the total power was considerably increased; an ordinary locomotive boiler was used instead of the Lentz boiler; the electric machinery is more compact and in general the details were better planned with regard to weight; the dimensions of the boiler, etc., are given; the steam engine has six single-stroke cranks with which absolutely perfect equilibrium is obtained; there is a continuous current dynamo at each end of the steam engine shaft, each generating 910 amperes at 450 volts; the dynamos have six poles and are connected in parallel; they are separately excited from a small dynamo run by a separate engine; the motors have four poles and are mounted without gearing on the wheel axles, but have a hollow shaft larger than the axle so as to cushion the motor; the motors are series wound. Some tests with one of the machines were made in January, but they did not include tests at high velocities; the probable results are given; 1370 indicated horse-power will be generated by the engine and 1006 will appear at the wheels, making the total efficiency 73.4 per cent. at full load; the total weight is 132 tons, which includes about 20 tons in the tender.

New Systems of Electric Railroads. ZEHME. *Elek. Zeit.*, March 25.—A long abstract of a recent paper in which he discusses and compares

what he calls the newer systems, meaning those which involve novelties as an entire system as distinguished from those which are still untried.

Accumulator Traction. Sieg. *Elek. Anz.*, March 11 and 18.—A reprint in full of a recent lecture in favor of accumulator traction and giving the results of practical tests made with an accumulator car on a private track. He states among other things that the great weight of the car is most objectionable when the car must be stopped frequently, which is the case in the denser parts of cities; to use the overhead line in the suburbs and the accumulators in the cities, as is done in a number of places, is therefore the reverse of the most favorable conditions for accumulator traction; he gives calculations comparing the costs of the overhead and the accumulator systems, showing how it may be determined for each special case which of the two systems is the best to use.

Accumulators in Power Houses. Schoop. *Elek. Anz.*, March 14 and 18.—A reprint in full of the paper noticed in the *Digest*, March 13.

Budapest Conduit and Overhead System. Moutier. *L'Eclairage Elec.*, March 20.—A continuation at some length of his description of the railways of that city, (see *Digest*, March 13). Illustrated descriptions of the conduit system (which has frequently been described before) are given, as are also descriptions of the overhead trolley system, including an illustration of the locomotive; tabulated records of the operation of these roads since they were started, are given in the form of two large tables.

Berlin.—Lond. *Elec. Eng.*, March 19.—In the continuation of the Sheffield report an illustrated description is given of the conduit system which is in use in Berlin. The issue of Mar. 26, contains a similar description of the lines in Dresden.

Electric Railway Practice in Europe.—St. Ry. Jour., April.—A series of brief illustrated descriptions of the railways in Aix-la-Chapelle, Versailles, Zurich, Hanover, Coventry, Brussels, Liege, Birmingham, Basle, Hagen, Hamburg and Lyons, together with some of the costs of operation.

Current Consumption of Electric Heaters. Douglas. *St. Ry. Jour.*, April.—A brief communication giving the results of some tests with 10 cars. It was found that the power consumed for heating was from 20 to 22 per cent. of that for both propelling and heating; that is, it takes about 5 horse-power or from 6 to 7 amperes to heat a car.

Cost of Operation of Electric Railway.—St. Ry. Jour., April.—The first of a series of articles giving the financial history of some American street railway properties, those of New York, Massachusetts, and Pennsylvania being the subject of the present installment; it includes horse and cable railways.

Lorain and Cleveland Railway.—St. Ry. Jour., April.—A brief illustrated description of the power house.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

High Tension Continuous Current Supply. Wyllie. Lond. *Lighting*, March 25.—A short article in which he gives some details of the working of the Walsall station, where such a system is used. The particulars in which the plant differs from the Oxford model have proved to be unquestionable advantages and the first year's run has been an unqualified success; the voltage at the generating station is 2000 instead of 1000; the commutators on both the generators and the transformers both run sparklessly; the greatest advantage has proved to be the joining of the transformers and their "pilot meters" to the generating station instead of to a separate distributing station; this gives a much more perfect control; the system is claimed to possess all the advantages of the high tension alternating and the continuous current supply, among which are the possible use of batteries. The generators are 80-kw and the transformer 40-kw machines; there are three transformer sub-stations and the low tension mains are on the two-wire system; neither generators nor transformers need ever be run on a very light load, as the battery is always charged during the earlier hours; some of the load diagrams are given; the loss of power in the transformer is the only considerable one; the transformers which are started as high tension series motors are, after reaching full speed, excited entirely by a shunt at the low tension end, the high tension series winding being automatically short circuited by means of a magnetic cut-out; the machine will start with a small current not exceeding 8 amperes; the low tension system was not adopted because a suitable locality could not be found for the central station; the sub-stations are 700, 1100 and 1300 yards from the generating station and they are visited only occasionally while running; a few particulars as to capital, outlay and working costs are given.

Electric Lighting of Country Houses. Graham. Lond. *Elec. Rev.*, April 2.—A reprint of an Institution student's paper. He discusses the choice of motor power including wind, water and gas, and shows that the initial outlay for such a plant is not very great, and that the light once installed is not much more expensive than other illuminants, being in some cases even cheaper; accumulators are considered absolutely essential; little is said of the cost of installation but the cost of working is discussed more in detail, accompanied by a few actual results.

Electrical Installations. Bochet. *L'Eclairage Elec.*, March 6 and 13.—A continuation of his lecture (see *Digest*, April 3). In the former he discusses accumulators in central stations, including illustrations of switchboard arrangements and in the latter, the subject of wiring and distribution, including a number of tables.

Worcester.—Lond. *Elec. Rev.*, April 2.—Extracts from the recent report concerning the extension of this station (see *Digest*, March 20).

Design and Construction of Electric Power Plants. Arnold. *West. Elec.*, April 10.—A continuation of the reprint of his lectures (see *Digest*, April 10); he discusses the cost of the production of power. These lectures appear to be a general summary of the subject, and are to be quite long; they will not be referred to again in these columns; as stated last week they are to be continued in that journal for a period of about three months.

Storage Battery Engineering Practice. Appleton. *Elec. Eng.*, March 24, 31 and April 7.—A continuation of his serial. He gives brief illustrated descriptions of the American and English accumulators, discusses the applications and uses in general, enumerating and describing the well-known uses to which storage batteries may be put, and describes the installation, care and maintenance of batteries.

Providence. Wetzler. *Elec. Eng.*, April 7.—A long, profusely illustrated description of the composite station of the Narragansett Electric Lighting Company, which is claimed to be a typical one; a suggestion for a storage battery sub-station is included.

Storage Battery Plant in Brooklyn.—Elec. Rev., April 7.—A brief illustrated description of the plant recently installed in one of the Edison stations in Brooklyn.

Isolated Plant. Coho. *Elec. Eng.*, March 31.—An illustrated description of a private plant at the Hillside Home, Scranton, Pa.

WIRES, WIRING AND CONDUITS.

Rail Connections. Hoefer. *Elek. Zeit.*, March 25.—The rails are often used in railroad telegraphy for the return earth current, the resistance between them and the earth being in most cases not more than one-half an ohm, while with a good water pipe connection it is not below 20 ohms; the rails are very effective until there is a frost when this resistance can be so high as to exceed that for the water pipes. It has, therefore, been found desirable to use the rails, but also to connect them with the ground; such a connection, which has been in use for a number of years and shown itself to be very satisfactory, is described and illustrated; an earth connection is made at the fish plate through the medium of a wire run into the earth but wound in the form of a coarse spiral in order to lessen the effects of vibration.

Rules and Regulations. Szapiro. *Elek. Zeit.*, March 25.—A brief communication calling attention to the fact that in the recent published regulations for Switzerland the loss of voltage for the most distant lamp is limited to 3 per cent., a rule which is not included among those recently adopted in Germany; he shows the desirability of such a rule owing to the evil effects which might arise by too great a difference of potential between different parts of the same lead; there can for instance be quite great differences between two earthing points thus leading quite large currents through the earth.

Preparation of Poles for Line Wires.—Jour. Telegraphique, March 25.—A note from a Scandinavian paper describing the effect of stripping a tree of its bark some time before felling it, so that the tree in dying will cause the pores of the wood to be filled with resinous substances which acts as a preservative, as described in the *Digest*, Feb. 6, and stating that the Government Telegraph Department is furnishing funds for making systematic and continued experiments under the direction of Ammundsen.

Wiring. Bonfante. *Bul. Soc. Int. des Elec*, February.—A reprint of the complete article which was noticed in the *Digest*, March 20.

ELECTRO-PHYSICS AND MAGNETISM.

Influence of Light on the Disruptive Discharge. Warburg. *L'Eclairage Elec.*, March 6; abstracted from the *Wied. Ann.* 59, p. 1.—Descriptions of experiments for studying the effect of a difference of potential between the two poles of a spark gap, a very short time after it has been established. He finds that a difference of potential which does not last more than a few thousandths of a second can, without producing a discharge, be seven times as great and even more than the static difference of potential, when the experiment is made in the dark, but it always produces a discharge in the light of an arc lamp at a value which is always greater than that of the static potential; the difference between the values for which the discharge is always produced and is produced only occasionally is very great for the dark and very small under the action of the light; the difference of the static potential varies but little when the cathode is illuminated.

Dielectric Constant of Ice and Alcohol at Very Low Temperatures. Dewar and Fleming. Lond. *Elec.*, April 2.—A reprint, in abstract, of a Royal tests made by the authors to throw light on the reasons for the differences. They conclude that the mean value of the dieletric constant Society paper, giving a list of determinations by others and describing of ice at —185° C for slow reversals is not far from 2.9 and for ethylic alcohol 3.12. They also measured approximately the dielectric resistance at these temperatures, the results being given in curves which show that in the case of alcohol the resistance begins to fall with great rapidity at —190° C.

Discharge of Conductors with Variable Capacity, Resistance, and Inductance. Petrovitch. *L'Eclairage Elec.*, March 13; abstracted from the *Comptes Rendus*, 124, p. 452.—A generalization of the theorems for the case in which all three vary with the time, during the discharge.

Liquid Coherers and Mobile Conductors. Appleyard. Lond. *Elec. Rev.* and *Elec. Eng.*, April 2.—An abstract of a Physical Society paper describing some interesting experiments with heterogeneous conductors made of emulsions of water and oil.

Electrostatic Theory. Leray. *Cosmos*, March 13.—A short, theoretical article forming a portion of a treatise on the synthesis of physical forces recently published.

Uranium Rays. Becquerel. *L'Eclairage Elec.*, March 13.—A long abstract of his recent paper (see *Digest* April 3) from the *Comptes Rendus*, 124, p. 438.

Magnetic Properties of Austrian Steel and Iron. Egger. *Zeit. f. Elek.*, March 15.—The first part of an article which seems somewhat elemen-

tary and in which he gives the results of investigations; it is chiefly of local interest.

Magnetization of Steel by Leyden Jar Discharges. VEILLON. *L'Eclairage Elec.*, March 6; abstracted, with illustrations, from the *Wied. Ann.*, 58, p. 311.—A study of the phenomenon observed by Hagenbach and the propagation of the oscillations during the discharge with their resultant magnetic effects.

Rotary Magnetic Polarization. VAN AUBEL. *L'Eclairage Elec.*, March 6; abstracted from *Jour. de Physique*, 5, p. 509.—He discusses the formula of Becquerel with special reference to the variation of a certain constant under the influence of temperature.

Magnetic Properties of Amalgams. NAGAOKA. *L'Eclairage Elec.*, March 20; abstracted from the *Wied. Ann.*, 59, p. 66.—Descriptions of experiments, with amalgams of iron prepared electrolytically.

Magnetic Properties of Soft and Hard Bodies. BECK. *L'Eclairage Elec.*, March 20.—A reply to the recent paper of KOHN (see *Digest*, Feb. 20), with whose conclusions he differs.

Diffraction of X-Rays and a New Method of Producing Powerful Rays. WOOD. *Science*, April 9.—A short communication preliminary to a detailed account of a work which will soon appear in the *Wied. Ann.* and the *Phys. Rev.* The trouble in obtaining diffraction has been in the want of a sufficiently intense source to give a diffraction with the very narrow slits which must be used; he found a new method of producing the rays by which the intensity per unit of area of radiating surface is from 10 to 20 times as powerful as in the best focus tubes; the rays are produced by an arc-like discharge between two very small beads of platinum in a high vacuum; the bulb is only about one inch in diameter; the source is an area of about the size of a pinhead; the arc appears to be a new form of cathode discharge, and can only be produced under peculiar conditions (which are not described). The images of a slit showed a distinct dark line, which he can explain only on the supposition that interference occurs; the plate is at too great a distance from the slit for such an effect to be produced by a reflection of the rays from the edges; images of fine wires show similar phenomena.

ELECTRO-CHEMISTRY AND BATTERIES.

Electricity in the Chemical and Metallurgical Industries. KERSHAW. Lond. *Elec.*, April 2.—The concluding article of his series (see *Digest*, March 20); in this he gives his views on the future of these industries and also the prospects of their development in Great Britain. A short table summarizes the number of electro-chemical and metallurgical undertakings in the various countries, which amount to a total of 142, of which 12 to 20 are experimental; Germany leads with 38 and the United States follows with 37, Great Britain and the colonies having 27 and France 18. The copper industry may certainly be regarded as a permanent one and the production will rapidly increase; aluminum will be produced by electro-metallurgical processes, although it is possible that the sulphide may be substituted for the oxide; attempts to use the ordinary furnace methods will probably never meet with success; the development will depend on the demand, which is not as great as was hoped; its use for boats has not been a success, which was due, according to Moissan, to the presence of sodium; its use is handicapped by the fact that it is much weaker than steel and more expensive than copper or brass; some of its alloys are very strong, but contain only a small amount of aluminum, wolframium and romanium are much stronger than pure aluminum, but cost more per pound; the reduction of the cost and the improvement in the purity are the factors which will determine the rate of development of this industry. The future of the industry in caustic alkalies and bleaching compounds is more uncertain; the period of competition with other processes is only just commencing and the two rival processes are formidable; it is more probable that the electrolytic process will exist as a rival of the other than that it will completely supplant them; the future of the chlorate processes is more certain and the indications are that it will be a permanent industry, the electrolytic process gradually supplanting the older one; large cheap water powers are important factors; the future of the gold recovery process is also assured; it is inconceivable that a cheaper or more satisfactory process should supplant it, but it is unlikely that it should survive in its present form; the production of pure silver is likely to remain a permanent industry; the future development of the calcium carbide industry depends solely on the demand for the material; the industry will be permanent, but it is doubtful if it will become great; the future development will be much less vigorous than many have been led to expect owing to the present overcapitalization of existing companies; the carborundum industry is likely to become a permanent one; cheap and large water powerr are essential; there appears to be a great future for the extraction of zinc from its ores and it is likely that this will become a permanent industry; the production of sodium and potassium is safe from rival methods but the industry can never develop into a large one unless new uses are found for these metals; the future of the Hermite sanitation process is doubtful, as it will have to compete with many rival processes; at a reasonable cost deodorization and not sterilization is alone effected; the future of the Elmore and like copper processes is not yet assured; the production of ozone on an industrial scale may be regarded as a permanent industry, but the demand is very limited; the material is very expensive; it must be used in conjunction with other bleaching agents as it will not bleach alone; the industry will become large if other uses for ozone are found; electrolytic methsolution of carbon in molten iron can be increased and with that also ods for manufacturing organic chemicals is likely to extend; the production of hydrogen gas as a bi-product might become a large industry if uses for it can be found; the white lead industry may become a very large one and there may be legislation in its favor owing to the other process being poisonous; electro-galvanizing processes are likely to extend gradually in the hardware business.

Crystalization of Carbon. BORCHERS. *Zeit. f. Elek.*, March 20.—A discussion of what he considers the best conditions for crystallizing carbon, that is, for the artificial production of diamonds. For the production of large diamonds Moissan's method must be absolutely excluded; Moyat's researches are briefly described and from both of them the following conclusions are drawn: That under high pressure carbon will crystallize from its solution in metals; that crystallized carbon, at least when under pressure, can stand temperatures which are above the solidifying point of carbonized iron; and that with high pressure the solution of carbon in molten iron can be increased and with that also the increased size of the crystals. He then describes at some length some researches which he had made some time ago and which he thinks may indicate a method of making diamonds of appreciable size; in his experiments small carbon rods were heated by a current and became soft; the more impure the rods the less current was required for softening them and the harder was the rod when cooled; all materials which form alloys with carbon will aid in the crystallization of carbon; besides the methods of Moissan and Moyat, he thinks there is a third method; the carbon is impregnated with a small amount of compounds, of a number of elements capable of being reduced, among which are boron, silicon, chromium, iron, etc., which form carbides or whose carbides can be alloyed with carbon; when these materials pass through the alternate formation and decomposition of carbides, they will probably produce a crystallization of the carbon gradually. All his experiments were made at atmospheric pressure and it is not improbable that better results could be obtained at higher pressures; a suggestion for a high pressure apparatus is illustrated.

Industrial Applications of Ozone. ANDREOLI. *L'Elec.*, March 13, 27, and April 3.—A continuation of his long serial (see *Digest*, March 6 and 27). This article is a sort of treatise on the subject of ozone, of which the author appears to have made a special study; it includes brief descriptions of a large number of actual and possible applications, but does not admit of being abstracted briefly. He refers to the curative action of ozone; it increases the appetite and the weight; the case of an ulcer is referred to, which was abandoned as incurable by other means, and was then cured by ozone; the lack of information concerning ozone in works on chemistry is pointed out; where reference to it is made, it is generally to ozone made of oxygen instead of air; the old method of production from the iodide of potassium is described; experiments made with the action of ozone on explosives are referred to and the importance of further experimenting pointed out; ozone from turpentine is discussed, as is also the disinfecting action; bacteriologists have shown that ozone destroys all the pathological microbes, even the most resisting; the chemical reactions of ozone are summarized and a number of applications of ozone are described; the importance of experimenting with the action on beer is pointed out and it is thought that beer thus created could be transported to great distances; the seasoning of wood for pianos and other purposes is discussed; some data is given concerning the action on starch as obtained by a plant installed by Siemens and Halske; ozone when dry does not bleach and it cannot be expected to replace peroxide of hydrogen or chloride of lime; ozone without combination with another agent does not bleach; the application to the aging of wines is discussed.

Rapid Rate Accumulators. BLANCHON. *L'Ind. Elec.*, March 10.—And abstract of an International Society paper in which he refers chiefly to the Tudor accumulators constructed for rapid rates. In these there is a great surface exposed to the action of the electrolyte, it being 25 sq. dcm. per kg of electrode; the current density may be 6, 8 and 10 amperes per kg for charge or discharge without appreciably affecting the available capacity; a curve is given showing the available capacity as a function of the time of discharge, as also the current for each case; in a discharge of two hours the capacity is 65 per cent. of that at ten hours, and at one hour it is 45 per cent., while at half an hour it is 30 per cent.; he states that it seems almost impossible to make light accumulators having a great capacity and capable of being used at high rates; the company therefore constructed a medium weight accumulator capable of being used at high rates in which the available capacity is not altered by the rates; these are charged at a constant potential of approximately 2.58 volts per cell; the current at start is about 180 amperes, falling to 80 in twenty-one minutes; 15 per cent. of the charge is completed in five minutes; 25 per cent. in nine, and 46 per cent. in twenty-one minutes; the first trials will be made at Puteaux. In the discussion Margaine gives some results with a Blot accumulator.

Accummulator. MONTERD system. *L'Elec.*, March 20.—A brief illustrated description of this accumulator in which the plates are concentric cylinders, one side of each of which is grooved and contains the active materials; the object appears to be to avoid buckling.

Soldering the Electrodes of Accumulators.—Bieblaetter 9, p. 813; abstracted in the *Jour. Inst. Elec. Eng.*, March.—The strips are immersed in strong potash and then washed in water; they are scraped clean at the joints immediately before soldering; lead, heated considerably above its melting point, is then poured into a pair of tongs, which surround the joint, serving as a mould.

Iron Chloride-Carbon Cell. KUESTER. *Zeit. f. Elektrochemie.* March 5; translated in the Lond. *Elec.*, March 26.—An unfavorable criticism of the cell recently suggested by Pauling (see *Digest* March 6) consisting of iron and and carbon in chloride of iron. He thinks it improbable that chloride of iron should be formed at the anode and again lose part of its chlorine at the cathode, and offers another explanation; he thinks there will be a strong local action on the iron due to the carbon which it contains as impurity; this solution, it was claimed, should be as concentrated as possible but in that case it will even dissolve iron when no current is flowing. He concludes that it is not likely that these cells will be a success.

Irreversible Cells. TAYLOR. *Jour. Phys. Chem.* 1, p. 11; abstracted in the *Proc. Lond. Phys. Soc.*, March 1.—He discusses the E. M. F. of such cells, and concludes that the difference of potential between a metal and an electrolyte is not a function of the ion of the salt solution, and that in certain cases dropping mercury electrodes do not give correct values for the single potential difference measured by that method.

Theory of Electrolytic Dissociation. CARARA. *Zeit. f. Elektrochemie*, March 20.—A brief abstract giving the results of experiments showing that the dissociating action of methyl alcohol is analogous to that of water.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Quadrant Electrometer.—*Zeit. f. Instrumentenkunde*, March; noticed briefly in the Lond. *Elec.*, April 2.—A description of a qaudrant electrometer which is said to place the recent French and American attracted disc patterns hopelessly in the shade in the matter of sensitiveness; the needle is charged by a Zamboni pile attached to it and suspended by a quartz fibre to which the extreme sensitiveness is said to be due; the difficulties heretofore encountered were due to the inconstancy of this dry pile, which is now overcome by using coatings of tin and lead peroxide for the paper elements; 0.01 volt gave a deflection of 72 mm at a distance of 2 m; the period is 20 to 30 seconds and the cost about $60.

Currents in the Branches of a Wheatstone Bridge. CREHORE and SQUIER. *Phil. Mag.*, March.—A partially analytical and partially graphical discussion of the currents in the branches of a Wheatstone bridge when each branch contains resistance and inductance, and when there is a harmonic impressed electromotive force. The purely analytical method gives equations which are too cumbersome to be of much practical use, but for the case of zero current in the galvanometer there is a simple way of determining the conditions for a harmonic E. M. F.; the graphical method gives so much more than the analytical that it is preferred. The article does not admit of being abstracted, but among other things they deduce an equation which shows that when a harmonic E. M. F. is impressed on one of the branches of a Wheatstone bridge, a galvanometer in the conjugate branch of the bridge can only indicate zero current when the impedances of the remaining four branches of the bridge form a simple proportion.

Insulation Measurements of Circuits. SKUTSCH. *Elek. Zeit.*, March 11.—An article of a mathematical nature in which he discusses the various branch circuits of the leakage through the insulation in systems of wiring in which there are more than two conductors; such branch currents will flow between all points having comparatively large differences of potential, as for instance between parts of the leads when two arc lamps are connected in series across an incandescent light circuit; measurements, to be complete, should include such leakage currents also. The article is long and the style is such that it is not very easily followed; no practical conclusions are given.

Measuring Cable Currents.—Lond. *Elec. Rev.*, April 2.—A comment on the recent communication of Christophersen (see *Digest*, April 10). It questions whether his results are more than those obtainable from other well-known tests which are mentioned.

New Method of Determining Large Resistances and the Capacity of Capillary Electrometers. KASANKIN. *Jour. Russian Physico-Chemical Soc.* 28, p. 15; noticed briefly in the *Zeit. f. Electrochemie*, Feb. 20.—He shows that it requires an appreciable time to charge a capillary electrometer to a given potential under certain conditions; the equation which he gives shows the possibility of measuring the capacity of the electrometer and unknown resistances by means of the time required for charging.

Mounting Instruments. ARMAGNAT. *L'Eclairage Elec.*, Feb. 27.—A continuation of his long serial on electrical instruments; he discusses the setting up of instruments, the adjusting, the protection against vibrations, insulation, etc.

Keys and Commutators. ARMAGNAT. *L'Eclairage Elec.*, March 6.—A continuation of his serial on electrical instruments; illustrated descriptions of keys and commutators are given.

Platinized Electrodes and Resistance Measurements. KOHLRAUSCH. *Wied. Ann.* 60, p. 315; abstracted at some length in the *Zeit. f. Electrochemie*, Feb. 20.—Descriptions are given of various forms of electrodes, cells and methods of platinizing.

Measurement of Temperature. CLARK. Lond. *Elec.*, April 2.—The conclusion of his series of articles on the measurement of temperature by measurements of resistance (see *Digest*, Jan. 30). The present portion is devoted to an illustrated description of the Callendar-Griffiths resistance box.

Rheostats. KOHLRAUSCH. *Wied. Ann.* 60, p. 333; abstracted in the *Zeit. f. Electrochemie*, Feb. 20.—He recommends going back to the old form of plug resistances, and gives some figures for the resistances of the plugs; he also proposes a new arrangement, in which the units, tens and the hundreds each form a group connected with each other by an infinity plug, both sides of which are provided with terminals.

Apparatus for Exhibiting Alternating Current Curves. BRAUN. *Wied. Ann.* No. 3; noticed briefly in the Lond. *Elec.*, March 26.—The indicator is a cathode ray which falls on a fluorescent screen and is periodically deflected by a magnet carrying the alternating current; the indicator is free from inertia and from a period of its own; a revolving mirror is used to draw out the vibrations into a curve.

Vibration Galvanometer. GRANQUIST. *Transactions of the Lund Physiographical Society*, 1896; noticed briefly in the Lond. *Elec.*, March 19.—A description of his instrument; a needle is suspended by a torsion wire inside of a coil carrying an alternating current; the vibration is a maximum when the natural period of the needle coincides with the frequency of the current; it is used for comparing the intensities of two alternating currents of equal period and determining the phase difference.

Classification of Electrical Measuring Instruments. CAMPBELL. Lond. *Elec.*, April 2.—A scheme for the classification of all common types of electrical measuring instruments, similar to the classification of galvanometers described in the *Digest* last week.

Photometry in the Industries.—*Elek. Zeit.*, March 25.—An editorial statement to the effect that the gas and electrical industries in Germany have come to an agreement concerning the photometry of lights; what this agreement is has not yet been made public.

Use of the Secohmeter. COLARD. *L'Eclairage Elec.*, Feb. 27; the conclusion of his article (see *Digest*, March 20).—He discusses the application of this instrument to the Pirani and analogous methods.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Lifting a Buoyed Cable End. SCHAFFER. Lond. *Elec.*, April 2.—A brief reference to the method described by Taylor (see *Digest*, March 20), stating that it is practical only in certain depths; the process of lassoing has been adopted with complete success for some four or five years.

Cable Steamer Portena.—Lond. *Elec. Rev.*, *Elec. Eng.*, and *Elec.*, April 2.—A brief description of this new French steamer, built in England, the two former journals containing some illustrations of the gear.

Bell Telephone Co.—*Elec. Eng.*, April 7.—Extracts of the annual report of this company.

MISCELLANEOUS.

Electric Heating and Cooking. COLIN. *Bul. Soc. Int. des Elec.*, February.—A reprint of a long paper discussing the construction of the apparatus, and with the aid of calculations the generation of the heat in them, followed by illustrated descriptions of some forms of commercial apparatus, which are those made by the Crompton Co. The metal iron was chosen for the apparatus itself because its coefficient of expansion was most nearly equal to that of the enamel surrounding the wire, which latter is made of German silver, ferro-nickel, platinum or iron. In practice it has been found that a temperature of 300° C in the wire could not be exceeded; calculations are made of the temperature surface, etc., among which are the following results: For a temperature of 200° C at the surface 3492 calories will be emitted per sq. m. per hour; with a surface of one decimeter per hectowatt the conditions will be the best; for broiling chops the surface temperature should be from 270° to 280° C; the total heat emitted per sq. m. will then be 11,922 calories per hour; the surface of such a broiler, 20 cm by 14 cm, will require 140 watts per sq. decimeter; for ordinary heating 120 watts is the best. Calculations of the cost are given, based on a cost of 12 cents per kw-hour when taken from street mains; assuming that it takes ten minutes to cook a beefsteak, the cost will be one cent. Apparatus for heating a room are then described, accompanied by some calculations; in practice 80 watts are required for well-ventilated rooms and 65 watts for small, enclosed rooms per cb. m.

Oil as an Insulator.—*Elek. Zeit.*, March 18.—An editorial pointing out the probable reasons why oil has failed in some cases. Some experiments made by the editor some years ago are briefly referred to; two transformers operating at 14,000 volts were connected by a Brook's cable several hundred meters in length (the Brook's system consists of ordinary cotton-covered wires run through a pipe containing a heavy oil); the transformers were operated for a number of weeks every day and in no case did a fault arise in the lines, while in the transformers seven short circuits occurred; the transformer boxes were filled with the same oil as the Brook's tubes, the only difference being that in the conductor tubes the oil was completely protected from contact with air, while in the transformer boxes there was a large surface of the oil exposed to the air; on this surface the origin of the short circuits could be seen; the oil was seen to circulate and small clouds of steam issued from the surface, which was soon followed by a short circuit; this showed that it was not the oil which was unreliable but merely oil in contact with air, and that oil can be used and relied upon absolutely, when it completely fills the transformer box, provision being made for expansion. The recent experience in Portsmouth is pointed out; here transformers filled with oil have been used but after having been very satisfactory for six months one after the other of the transformers was burned out; the explanation of Prof. Garnett is quoted; according to him, the oil used was oxidized resin oil whose specific gravity was greater than that of water and it was thought that the water would float on the oil, but this theory is not correct; when a petroleum lamp remains unused for some time water will be found collected in the wick; a similar action takes place in the transformer; the oil instead of keeping off the water seems to act as a carrier of water to the cotton insulation; the circulation of the oil due to the heat is supposed to carry small particles of water down to the cotton insulation and after a sufficient quantity is collected a short circuit occurs. Garnett's explanation agrees with the observations above described.

Ozone. SHENSTONE. Lond. *Elec. Rev.*, March 12.—A short note calling attention to a recent paper by that author read before the Chemical Society, on the action of the silent discharge on pure substances. Regarding the behavior of oxygen when fully dried and when saturated with water vapor, he found that, contrary to the statement of previous investigators, oxygen is most freely converted into ozone when wet, and that well dried oxygen yields only a very minute percentage of ozone; ozone in ozonyzed oxygen is far more stable in the presence of water vapor than in its absence.

Deflection of Bullets by Electric Currents.—*Elec. Rev.*, April 7.—A reprint of a short article from the New York *Sun* describing some experiments recently made in Switzerland. It was found that projectiles had been deflected from their course by telephone wires; an experiment was therefore made with four wires parallel to the line of fire and 125 feet away

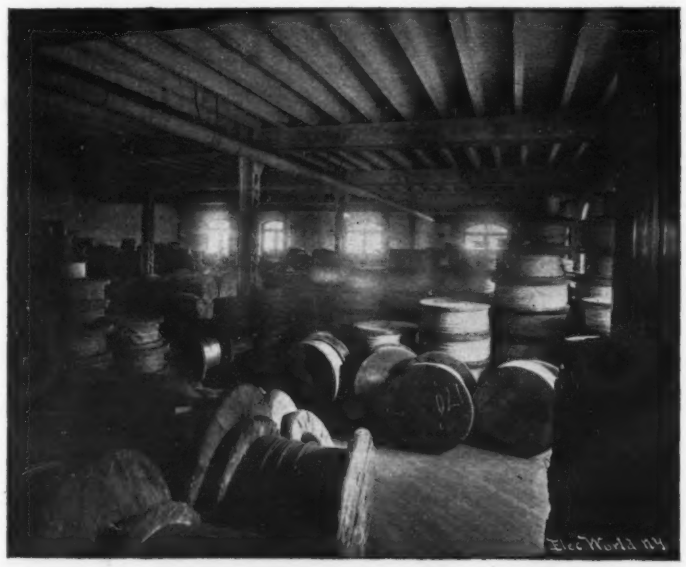
from it; "an electric current of 8000 volts" was sent through the wires and its influence was unmistakable; at 275 yards the deflection of the bullets from the straight course was 75 feet; a trial with cannon balls showed that there was a deflection, although it was less.

Hardening Metallic Surfaces.—West Elec., April 10.—A reprint of a paper read before the Canadian Society of Civil Engineers. The method is described by which car wheels have been shaped and surface hardened by contact with a rapidly revolving disc, which causes sufficient heat at its point of contact to harden the surface; he then states that a greater heat efficiency can be obtained from the electric current applied at the points of contact, thus involving considerable saving by applying a large percentage of the power electrically; the coefficient of friction is also greatly increased by even a small current, thus lessening the power consumed in bearing friction; it is estimated that the life of tires thus treated will be at least double; the process is also peculiarly well suited for finishing and hardening journal surfaces; the expense is but slight; a table of results is given for both of the methods and shows only a very slight percentage of difference between the two (apparently meaning the efficiencies of the machines) and it is thought that a much better efficiency can be obtained with the electric method when the machine is properly adapted.

Electric Heating of Niagara Falls Station. DUNLAP. *West. Elec.*, April 10.—A brief illustrated description of the heaters and the method of heating of that power station, which is said to be the largest electric heating plant in the United States, if not in the world; the maximum amount of power used in heating is from 420 to 430 horse-power, which, together with 120 horse-power converted into heat in the dynamos themselves, amounts to about 700 horse-power.

Well-Known Electric Wire Works.

The immense works of the John A. Roebling's Sons Company are located in about the central part of Trenton, N. J., on the Delaware and Raritan Canal, and also on the main line of the Pennsylvania Railroad. The entire works cover an area approximately about 25 acres, and the electric wire making department is probably one of the most important sections of this vast institution, being as large, if not larger, than any similar manufactory devoted to this product alone. About one-half of the entire area occupied by this establishment is given over to electric wire making and insulating. The variety and quantity of the product are of interest in what may be called this wire age.



STOCK ROOM FOR ELECTRIC WIRES.

It may well be said that there is no type of wire used for electrical purposes which is not produced at this manufactory, beginning with the primitive galvanized iron telegraph and telephone wire to the highest grade of rubber and paper insulated lead cables and including braided weatherproof, rubber-covered house, magnet and annunciator and bell wires, flexible cables, cords, etc. A specialty is made of paper insulated cables, in which direction it may be said that the concern is a pioneer, having begun their manufacture as far back as 1890. Since then this product has been specially developed and perfected, forming to-day a most important part of the electrical wire products of the company. It may be noted that these cables are being used for submarine work, which is probably somewhat of a new departure. A cable of this construction is at present in use between Camden and Philadelphia for telephonic purposes. This form of insulated cable is also being used quite extensively for electric railway feeders, a large amount having been used by the Union Traction Company of Philadelphia for its underground transmission system, and also for the conduit system of the Metropolitan Railroad Company, Washington, D. C. A great portion of the new Metropolitan Railway conduit system in New York City will also be equipped with this cable.

In the line of braided line wires no recent departures have been made, the product still maintaining its uniformity of excellence. Two, three and more cotton braids are used, which are impregnated with the company's insulating compound. A visit to the wire braiding and insulating shops showed an excellent arrangement of machinery, and the visitor is impressed with the expeditious processes and the general excellent working of the machinery. Three large buildings are devoted to the winding, braiding and insulating processes alone, the immense rolling and drawing mills being entirely separate.

The maximum daily shipment of insulated wires, including all types, reaches about three carloads during the busy season. This means the consumption of from 600 to 700 tons of copper per month. The bare copper and iron wire output even far exceeds this. Indicative of the progress of this portion of the business, it may be noted that the first weekly payroll of the electric wire department, in 1885, was $36, with less than ten employees. To-day the weekly payroll reaches several thousand dollars, and there are over 700 men and boys employed.

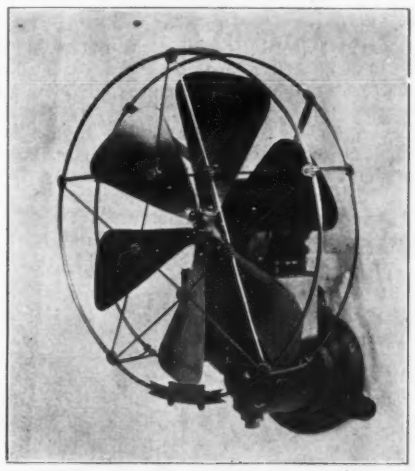
Mr. F. J. Newbury is directly in charge of the electrical department, while the concern as a whole is still controlled and operated by the Roebling family. Col. Roebling is president, C. J. Roebling vice-president and F. J. Roebling secretary and treasurer.

Fan Motor.

The accompanying illustration represents a fan motor which is the outcome of many years of experience in the manufacture of such machines. It is being put upon the market by Messrs. Roth Bros. & Co., 32 Market Street, Chicago, Ill., and has a number of special features which commend it to the consideration of all interested.

The base and magnet frame are connected by a ball joint which is adjustable and permits the use of the motor either as a wall or desk fan, and adjustment to throw the breeze in any direction desired.

The armature core is built up of sheet-iron stampings and is solidly constructed and well insulated. The connections of the armature coils with the commutator segments are made by wire comparatively heavier than that ordinarily used, thus avoiding a trouble which is very common in some makes of machines of this class. The segments of the commutator are clamped on a brass sleeve and are thoroughly insulated from the sleeve and from each other by white India mica. Self-feeding carbon brushes are used and the carbon holders are adjustable in two directions. The shaft is turned from cold rolled steel and runs on self-oiling bearings.



WALL FAN MOTOR.

The base contains a switchboard and regulating resistance consisting of German silver wire insulated with asbestos.

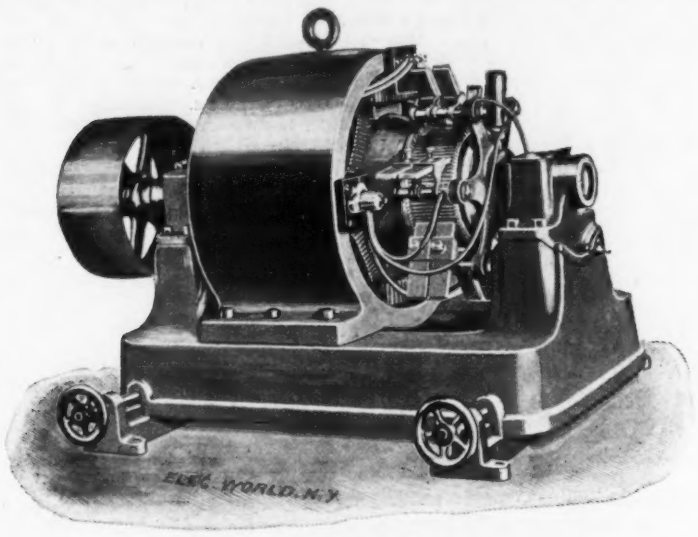
These motors are run at three different speeds; namely, 1,100, 1,400 and 1,800 revolutions per minute. They are provided with either 12 or 15 inch brass fans and have guards of artistic design. They are wound for 110 volts direct current, but may be wound for any voltage up to 220, and in general appearance they are not surpassed by any fan motor on the market. The New York Dynamo & Motor Company, 257 Broadway, New York, is the agent for Roth Bros. & Co.

Direct-Current Multipolar Machines.

The construction of direct current machines of the multipolar type has become so refined in the last few years that there seems scarcely any room for further improvement in such apparatus. The rough treatment received by many machines after their installation, and the hard work and frequent overloads which are generally imposed upon electrical machinery, require that the mechanical construction of both generators and motors should be as simple, as solid and as reliable as possible.

The Quaker City Electric Company, Philadelphia, in the design of its new type of dynamo-electric machine, which is illustrated herewith, has endeavored to combine the greatest simplicity with the utmost strength and compactness. The centre of gravity of the machine is low and the distribution of weight on the ample bed-plate is uniform. The bearings are fitted with large bronze bushings and double oil rings in each journal. The coils are machine-wound on standard forms and are absolutely interchangeable. The armature shaft is unusually heavy,

and the winding is an excellent example of the generally-used deep-slot type. The ventilation of the armature core has been very carefully and thoroughly worked out. The commutator is of great size and very solid construction, tempered copper segments being used with mica insulation. The generous proportions of this commutator is one of the most



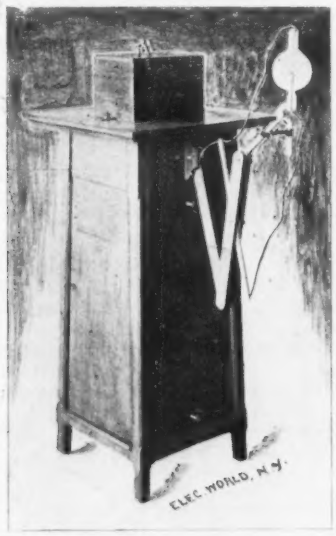
Direct Current Generator.

valuable features of the machine, insuring a long life on account of the great room for wear. The field ring being separated from the bed-plate, can be mounted on a special bed-plate for direct connection to any standard type of automatic engine.

Rontgen Ray Machines.

The latest development in the art of producing Rontgen rays is a machine which has just been placed upon the market by the Fessenden Manufacturing Company, Pittsburg, Pa., operating under the patents of Prof. Reginald A. Fessenden. The main points of this machine are simplicity both in design and operation. The Fessenden Company adopted as its chief object the production of a machine which, while giving the maximum spark results, which it is possible to obtain in the present state of the art, can be operated easily by any one of ordinary intelligence without knowledge of electricity or mechanics.

The structural appearance of the machine is shown by the illustration. The induction coil is built perpendicularly, and the resistance and condenser are so arranged that no adjustment of those appurte-



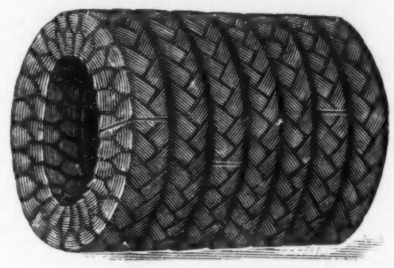
Rontgen Ray Apparatus.

nances are necessary. The cost of the operation is reduced to a minimum; a little oil and a few brass contact pieces, costing altogether only a few cents, being all that is necessary after a considerable run. The projecting rod on top of the machine is used as a starting device, it being only necessary to throw in the switch, push the starting rod, and the machine at once starts up without any further attention or adjustment. The speed is regulated by an adjustable brush-holder device. The starting and regulating devices are so grouped that the operator may manipulate the same with one hand, while at the same time holding the fluoroscope and taking views.

The framework of the machine is handsomely finished in oak, mounted on castors, and altogether the apparatus is particularly suitable as an article of furniture in a doctor's office. These machines are made to operate from either direct or alternating current circuits.

Waterproof Hydraulic Packing.

The continued increase of water pressures has created a demand for a superior hydraulic packing for plungers, pistons of pumps, pumping machinery, etc. Many of the best makes of hydraulic packing on the market have failed to meet all the requirements of practice, and they



Section of Packing.

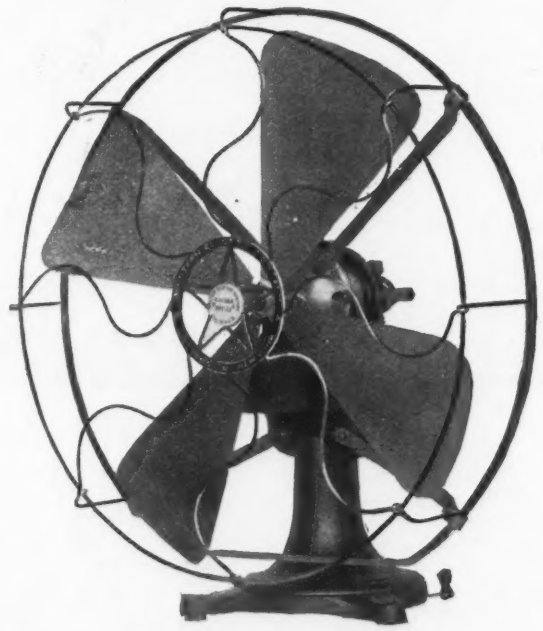
soon, from various causes, break down, resulting in leaks, requiring constant attention and frequent repacking.

The Garlock waterproof hydraulic packing manufactured by the Garlock Packing Company, Palmyra, N. Y., is the result of numerous practical experiments and tests on the water ends of pistons and plungers of hydraulic machinery, and the manufacturer claims it has produced a first-class article which can be relied on. It is made of the best quality of selected flax and lubricated with the company's waterproof compound, which is free from acid. This packing is furnished on rod and stuffing-box measurements only, since it must be of exact size to give the desired results.

Fan Motors.

A complete line of fan motors has been placed upon the market by the Western Electric Company, Chicago and New York. These machines are of 12 and 16 inch sizes, with rigid and adjustable bases, for desk and wall-bracket uses. Each has three speeds. The 12-inch motors are designed for 110 volts, while the 16-inch machines are made for 110, 220 and 550 volts, as desired.

The company is also making ceiling and column fans, with 60-inch blades, that can be run at two speeds. These motors are highly ornamental, being finished in polished brass and oxidized copper. The ceiling and column fans are wound for 110, 220 and 550 volts, as desired, and are usually supplied with two blades, although four may be had. They are also furnished with or without chandelier lights.



Desk Fan Motor.

The finish of all motors is artistic and graceful, and in operation they are very efficient. The 12-inch motors, it is claimed, consume less energy than any 16-cp lamp on the market, when running at full speed, while the 16-inch ceiling and column motors take but a trifle more current.

The high efficiency of these machines, it is stated, is obtained by the excellence of design and material of which they are constructed. The magnets are made of drop forged steel and the armatures are ironclad and metal incased. The brush-holders are of excellent design and possess some features that will be appreciated by those using this class of machine. The motors are provided with self-oiling bearings, one supply of oil being sufficient for an entire season.

A Storage Battery.

The storage battery is meeting with a greater demand every day, and the perfection to which this apparatus has been brought has enabled manufacturers of the same to give reasonable guarantees as to the performance of their products. A good Plante type of battery is favored by many manufacturers and users for many reasons, and among storage cells of this type, of American design and manufacture, the one illustrated herewith and made by the New York Accumulator & Electric Company, 150 Nassau Street, New York City, merits special attention.

The battery plate, Fig. 1, consists of a single integral piece of pure lead. It is an open-work, ribbed and grooved plate, without any border, the ribs of one side of the plate crossing those of the other side, being materially as well as electrically joined together. Where strength and durability are the first considerations, the plates are made heavier, every tenth rib being made thicker and the adjoining ribs wider. It is claimed that a plate of this construction has greater strength and a larger exposed surface for a given weight than any other form of ribbed plate.

Fig. 2 gives an illustration of a complete cell. The electrochemically

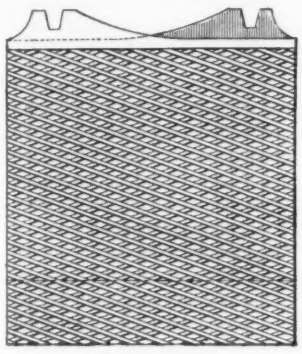


FIG. 1.—PLATE.

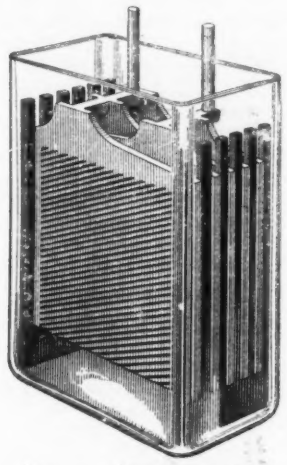


FIG. 2.—COMPLETE CELL.

"formed" active material is very fine grained in texture, and very compact and adherent. The average capacity of these cells ranges from 3 to 5 ampere-hours per pound of element, though a much higher capacity can be obtained where excessive lightness of plate is desired. The insulation of the plates is accomplished in a very succesful manner, and the battery will stand an excessive charge and discharge rate without injury.

For some purposes the positive plates are especially protected by perforated sheets of insulating material, secured to the plates by means of soft rubber bands, or otherwise. This method of construction prevents scaling or bridging.

This battery, we are informed, has been subjected to severe, repeated and continued tests for a period of eighteen months, without showing any signs of disintegration, decreased capacity or efficiency. It is manufactured under non-infringing individual patents, recently issued, and owned by the company, which is thus enabled to fully protect purchasers against litigation.

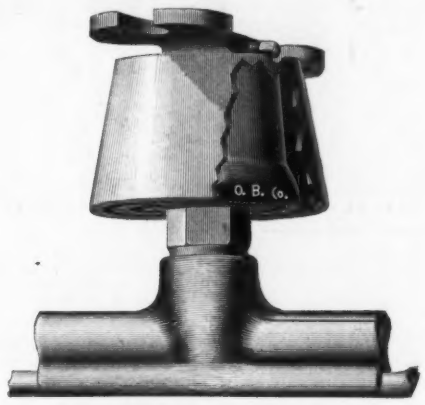
Improved Form of Trolley Wire Hanger.

The device illustrated herewith has been produced by the Ohio Brass Company, Mansfield, Ohio, to meet conditions necessitating the support of the trolley wire to a rigid superstructure, and it is constructed in such a manner as to afford greater mechanical strength and electrical insulation than are found in ordinary types of hangers.

This hanger was designed especially to meet the two very important requirements in overhead construction, namely, secure suspension and thorough insulation. The insulation is protected against the effects of accidental blows of the trolley wheel, and from dripping moisture from the overhead support, by a metal covering by which it is partially enveloped. Trouble usually arising from surface leakage is also avoided by this novel form of construction. The body of insulation is made with two ⅝-inch steel studs projecting from the upper and lower faces respectively, and is held in place in the casting by means of the upper stud which threads into it, and which is prevented from unscrewing by means of a small set screw arranged for this purpose. The lower stud serves as a means of attaching the various styles of ears and clamps to the hanger, and when so required can be varied in size to fit those which are tapped out for ½-inch or 7-16 inch studs.

The trolley wire clamp, shown in connection with the hanger body, consists of two jaws of bronze metal, hinged on an interlocking pin, which passes through the enlarged head of the stud bolt. The clamping effect is secured by screwing the cone-shaped nut down on the stud bolt, which spreads the upper part of the jaws apart, thus securely gripping the wire.

The stud bolt in the hanger body is threaded right handed and that in the clamp left handed, which arrangement allows the clamp to be either loosened or tightened on the wire by turning the cone-shaped nut in the proper direction. To facilitate this operation the nut is made hexagonal in shape on its upper end, and a small open end drop forged steel wrench is supplied with the hangers and clamps, of the proper size to fit it. This arrangement permits a longitudinal adjustment of the trolley wire without removing it from the clamp, which is found to be



TROLLEY WIRE HANGER.

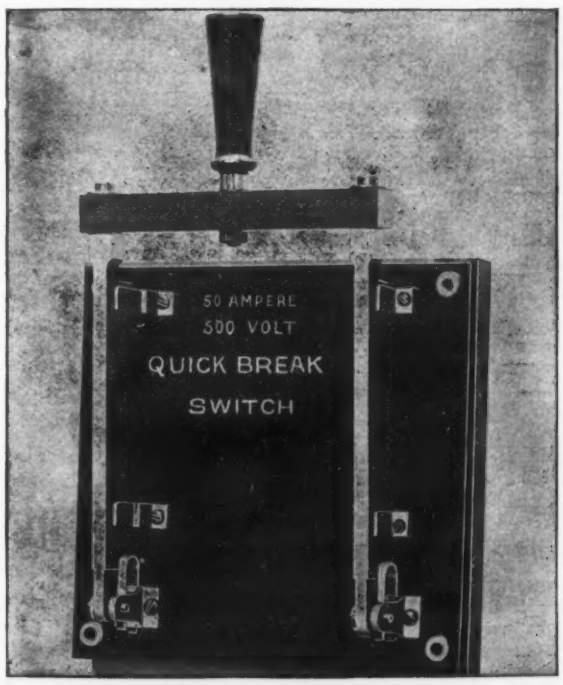
frequently necessary when cutting in or taking up slack. The sparking of trolley wheels in passing mechanical clamps is said to be overcome in this clamp, at the same time nothing is sacrificed in strength, and when used in combination with the hanger body, it is said to give very satisfactory results.

Quick-Break Switch.

The well-known Linton & Southwick switches for which the Shawmut Fuse Wire Company, 93 Federal Street, Boston, is selling agent, are held in high esteem by the electrical trade, and illustrated herewith, is one of its special manufactures, a two-pole, single-throw, quick-break switch.

This switch is rated at 500 volts and has a carrying capacity of 50 amperes. The blades are made of standard composition and are held firmly in place by a fibre cross bar of ample dimensions. The clips are of hard rolled copper and great care is taken to obtain a perfect alignment of all the parts. The whole is mounted on a base of marbleized slate which is carefully selected.

By a peculiar formation of the ends of the blades, where they enter the hinges, the quick-break action is secured. As soon as the blades are released from the clips, the springs, shown beneath the hinges,



QUICK-BREAK SWITCH.

cause them to immediately fly open. The switch is built to comply with the specifications recently issued by the Commissioner of Wires of the City of Boston and has been passed upon by the Boston Board of Underwriters.

The company has just brought out a new form of spring switch, similar to its standard switch. The blades are of rolled copper instead of being cast, and the clips are of sufficient height to project above the tops of the blades when closed. Thus a complete contact is secured even if a slight arcing should wear away the tops of the clips. A fibre cross bar takes the place of the metal one. The switch is highly polished and makes a very fine appearance.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 12, 1897.

ELECTRICAL STOCKS.—Edison Electric Illuminating of New York and General Electric preferred are the only shares in the list that show an advance over last week's quotations, the latter being 1 point and the former ½ higher. General Electric common lost ½ point, the sales of shares during the week being 2572. The highest point reached was 32 and the lowest 31¼, at which price the stock closed. Electric Storage Battery, both issues, dropped off about 2 points each, and Westinghouse remained practically unchanged.

TELEGRAPH AND TELEPHONE.—Bell Telephone closed at an advance of 3 points over the previously reported figures; Commercial Cable is unchanged while Postal Telegraph shows an advance of ½ point in the asked price. Western Union was more active and closed the week with a net gain of 1½ points. The highest figure reached during the week was 82¼, and the lowest 79½, the closing price being 81½. The total sales of this stock for the week were 19,308. The telephone list, excepting Bell Telephone, is unchanged.

ELECTRIC TRACTIONS.—This class of securities continues inactive with generally lower prices. Brooklyn City Railroad was the strongest and most active of the list, the advance being attributed to the satisfactory showing of the operations during March. There was a slight demand for Columbus Street Railway at about the same quotation as that last recorded. It was reported in Baltimore on April 10 that, notwithstanding official denials, negotiations are still in progress there looking to the consolidation of the Baltimore Traction, Baltimore City Passenger and the City and Suburban Railway Companies.

INCREASING BELL TELEPHONE STOCK.—A Boston dispatch states that the American Bell Telephone Company has issued a circular respecting the issue of 23,650 new shares of stock. According to the circular, each stockholder is entitled to take and pay for shares of the new stock in proportion of one share for every ten now held. This right to subscribe will expire on May 8 next.

	Par.	Bid.	Asked.
ELECTRICAL STOCKS.			
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	106½	108
Edison Electric Ill., Brooklyn	100	..	97
Edison Electric Ill., Boston	100	..	..
Edison Electric Ill., Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	21	21¼
Electric Storage pref	100	22¾	23¼
General Electric	100	31¼	31½
General Electric pref	100	73	74¾
Westinghouse Consolidated, pref	50	50	51
Westinghouse Consolidated, com	50	..	24
BONDS.			
Edison Electric Ill., New York, con. 5s	105	110	..
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	96	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	220	221
American District Telegraph	100	29	39
American Telegraph and Cable	100	87	89
Central & South American Telegraph	100	124	127
Commercial Cables	100	150	..
Erie Telephone	100	63⅞	64½
New England Telephone	100	..	102½
Postal Telegraph-Cable	100	96½	98½
Western Union Telegraph	100	81½	81⅝
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	19¾	19⅞
Brooklyn Rapid Transit	..	19	21
Brooklyn Traction	100	..	14
Brooklyn Traction, pref	100	46	48
Buffalo Street Railway	100	72	74
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	42½	45
Hestonville	100	50½	51
Hestonville, pref	..	..	62½
New Orleans Traction	100	4	6
New Orleans Traction, pref	100	20	25
North Shore Traction	100	20	22
North Shore Traction, pref	100	75	79
Rochester Street Railway	..	..	15
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	..	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	71½	72
West End, Boston, pref	100	91½	92½
Worcester Traction	100	17	19
Worcester Traction, pref	100	91	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	79½	..
Buffalo Street Railway 1st con. 5s	100	*106½	108½
Cleveland Electric Railway 1st mtge, 5s	100	103	105
*Columbus Street Railway 1st 5s	100	94	96
Rochester Street Railway 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	104	108
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, April 13, 1897.

THE BOARD OF ELECTRICAL CONTROL.—The present Board of Electrical Control in New York City will terminate its existence on November 1 next by limitation. A bill has been prepared for introduction in the Legislature at Albany providing for the extension of the life of the Board for four years.

PEREMPTORY SALE.—Messrs. Edwin S. Greeley and James W. Sands, ancillary receivers of The E. S. Greeley & Co., announce that they will sell at public auction the entire plant of that concern on Monday, April 19. The sale will take place at 5 and 7 Dey Street, and will include the firm's large stock of electrical and railway supplies, fixtures, etc., and will continue daily thereafter until everything is disposed of.

"MARINE ENGINEERING" is the title of a new-born journal which began its existence in April and will be issued monthly by the Marine Publishing Company, World Building, New York City. Mr. H. M. Swetland is president and general manager of the company, and Mr. H. F. Donaldson is secretary, and editor of the paper. As its title implies, the paper is devoted to marine engineering construction, propulsion and allied interests, and the first number is full of pertinent matter, some of which relates to marine electrical equipments. The color of the cover is green, but hardly a sea-green.

OUT-OF-TOWN VISITORS.—The following named out-of-town visitors registered at the headquarters of the National Electric Light Association during the week ending Friday, April 9: D. Urquhart, Fremont, Ohio; George W. Vallee, Philadelphia, Pa.; P. J. Bennett, Syracuse, N. Y.; C. E. Newton, Hartford, Conn.; H. Brooks, Boston, Mass.; A. P. Seymour, Syracuse, N. Y.; W. C. Bryant, Bridgeport, Conn.; C. E. Scott, Bristol, Pa.; A. D. Page, Harrison, Ill.; F. S. Terry, Chicago, Ill.; J. Wilson, Boston, Mass.; C. H. Rockwell, Cleveland, Ohio; J. C. Felton, Schenectady, N. Y.; H. C. Wirt, Schenectady, N. Y., and C. E. Bibber, Boston.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., April 12, 1897.

MR. H. L. PARKER, assistant engineer of the railway department of the General Electric Company, Schenectady, N. Y., delivered a lecture before the Boston Society of Arts, Thursday evening, April 8, on "Heavy Electric Railway Service."

THE CARTER ELECTRIC COMPANY, Springfield, Mass., has vacated its old quarters under the Massassoit House and is now located almost directly opposite, at 229 Main Street. Mr. N. P. A. Carter and Mr. B. C. Starr, who really comprise the company, are both wide-awake business men.

MR. W. W. BURNHAM, well and favorably known to the electrical fraternity through his connection for the past fifteen years with the Electric Gas Lighting Company, Boston, and also manager of the same for the past four years, has resigned his position, and will associate himself in business with Mr. J. L. Gethins, of "Gethins Battery" fame.

MESSRS. L. A. CHASE & Co., Boston, New England agents for the Atkinson Horseshoe Rail Bond has recently made some important sales of bond equipments, notably to the Newton & Boston Electric Railway Company, Quincy & Boston, Newport (R. I.) Street Railway Company, Taunton and Brockton roads and the Union Street Railway Company, South Framingham, Mass.

MR. CHARLES GARRISON, of the Shawmut Fuse Wire Company, Boston, has just completed a series of 1600 tests to determine the carrying capacity of fuse wire. A current as high as 1800 amperes was used. Several difficulties were brought to light, but there are a number of points still undetermined and he is now preparing another set of tests. Considerable attention is given to fuse wire just at present due to the attempt of Mr. Wm. H. Merrill, Jr., of the National Board of Fire Underwriters to establish some sort of standard.

THE DRAKE, PAYSON & WHITTIER ELECTRIC COMPANY, Providence, R. I., has recently been organized on an exceedingly strong basis, and in the matter of electrical supplies and construction, it is intended to push the business more aggressively than ever. Mr. W. P. Gannett, Jr., well and favorably known to the electrical trade, is now the manager and treasurer of the company, and under his direction, together with other prominent officials who will be an active force in the company, it is quite safe to predict for it a very successful future.

THE W. S. HILL COMPANY, New Bedford, Mass., manufacturer of the well-known Hill switches, has just issued a very attractive 88-page catalogue illustrating its numerous specialties. This company's switches are meeting with much favor. It makes a great variety of switches, for all uses and of all standard sizes and special sizes. Marble and slate switchboards are constructed by this company, as are also rheostats for special purposes. Mr. C. S. Mendell, treasurer and manager of the company, is now dividing his time between New Bedford and the Boston office and in his intercourse with the trade is meeting with excellent success in the line of orders.

THE ANCHOR ELECTRIC COMPANY, Boston, has been forced to secure a new factory for its manufacturing business, owing to the rapid increase in the demand for its various products. The factory is now located at 301 Congress Street, overlooking Boston Harbor. New machinery has been added, and when things are in running order the Anchor Company believes that it can justly claim to be possessed of the largest facilities for the manufacture of its line of specialties, which comprises sockets, switches, cut-outs, watchman's registers, gongs, machine screws, etc. Its line of flush switches and new push button switches will require a considerable floor space if orders continue to come in as they have for the last few months.

THE FRANK RIDLON COMPANY, 180 Summer Street, Boston, is entitled to the credit of being the pioneer in the field of exchanging and repairing electrical apparatus. Having a small beginning, it has grown to be an active working plant of surprising magnitude. A recent visit to the factory of this company revealed the fact that it occupies the space of 15,000 square feet. It is divided into five principal sections—a stock room, a repair room, a polishing room, a transformer room and a store room. In the stock room are kept all the spare parts which are needed in repairing dynamos, motors, transformers, arc lamps and watt meters. One corner of the repair room is devoted to the winding of armatures and fields. Another part of the room contains the machinery, consisting of lathes, drills, milling machine and winding frame, all driven by an electric motor. Here commutators can be repaired, refilled and turned down in a prompt and efficient manner. The polishing room contains a motor-driven buffer, and the transformer room has a 1000-volt alternating circuit for testing transformers after being repaired. A step-up transformer is mounted on the wall to furnish 2000 volts when required. In the repair room is a 110-volt circuit, a 220-volt circuit and a 500-volt circuit for testing motors, besides two constant-current circuits of 6, 8 and 10 amperes respectively for testing arc lamps. Besides a regular travelling crane, the Frank Ridlon Company has a novel 4-ton crane which was designed and built in the factory. It consists of a standard, mounted on four low iron wheels with very wide tires. Two men can readily move a large piece of machinery to any part of the room. The company employs 25 skilled men, and has facilities for doing any sort of repair work in first-class manner and in the shortest possible time. Every piece of apparatus turned out is as good as new in every respect. Besides repair work, the company re-designs machines for all sorts of service, and it has on hand at all times dynamos, motors, arc lamps and transformers, besides manufacturing especially the Doane rheostat. Mr. Frank Ridlon is still quite active in the affairs of the company, but the management in the main is under the charge of Mr. E. W. Kellogg, secretary and treasurer, who, by the way, has spent almost his entire business career in the electrical field, having always held conspicuous positions, and filled them with credit to himself and profit to his principals.

TRENTON (N. J.) NOTES.

THE UNITED RUBBER COMPANY, Trenton, N. J., includes among its various manufactures an excellent line of rubber tubing for electrical purposes.

MR. J. W. COVERT, corner of Hanover and Broad Streets, Trenton, N. J., is kept very busy by a rush of new installation work. Mr. Covert has lately paid a great deal of attention to telephone installations.

WIRE DATA.—A new book on wire data will shortly be brought out by Mr. F. J. Newbury, manager of the electric wire department of the John A. Roebling's Sons Company, Trenton, N. J. The excellent character of the previous book has caused the demand to exhaust the entire edition. It is promised that the new book will include much entirely new and novel data, and will surpass its predecessor in many features.

THE HOME TELEPHONE COMPANY, Trenton, N. J., an independent telephone concern operating in this section, seems to be meeting with excellent success. This company uses the system invented by Mr. Paul Minis, of the Best Telephone Manufacturing Company, Baltimore, Md. The system embodies a number of extremely novel features in the central station apparatus and in the individual telephone sets. Mr. E. B. Barneman, general manager of the Home Company, is very enthusiastic over the possibilities of independent telephone operation. The Home Company already has several hundred 'phones connected, with over 1000 subscribers, and, at the fair rates which it offers, there is no reason why it should not prosper vastly in excess of this.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., April 12, 1897.

NEW WORK UNDER WAY.—The Niagara Electric Chemical Company is about to put in new transformers constructed by the Westinghouse Company. They are of 200-hp capacity.

THE MATTHIESON ALKALI COMPANY has about completed its big transformer house, which is 298 by 212 feet. It is stated that it will at once erect its new bleaching chambers adjoining, which will be 210 by 100 feet. The Westinghouse Company has made for this company eleven 200-hp transformers.

WANT TO LIGHT LANCASTER.—Several companies are aspirants for the contract to light the village of Lancaster during the coming year. It is thought that the Lancaster and Depew Power & Conduit Company, which has asked for a franchise permitting it to furnish the village with electricity for heating, lighting and other purposes, will be the successful competitor. This company will get its power from Niagara Falls. It has already secured a franchise from the village of Depew.

ANOTHER NIAGARA POWER USER.—In all probability the manufacture of hair-cloth will be an industry in this city before the Summer months have passed. It is stated that the McSlay Brothers, of St. Catherines, Ont., who are extensively engaged in the manufacture of this material, will locate a branch factory in this city. They are negotiating for temporary quarters in the Pettebone-Cataract Paper Company's Mill Building, and the power to operate their plant will be furnished by the Niagara Falls Hydraulic Power & Manufacturing Company. Later on they will erect a building of their own for permanent quarters.

NO POWER FROM NIAGARA.—For ten hours on Sunday last, April 11, Buffalo had no Niagara power. The current was cut off at 7 o'clock in the morning and was not turned on until 5 o'clock in the afternoon. At the foot of Auburn Avenue the conducting cable is laid in a tile conduit under the bank of the Erie Canal. The bank gave way on Saturday to such an extent that it was feared that the conduits would be broken, and for that reason temporary wooden boxes were made, in which three cables, each 1000 feet long, were placed. These will be used till the danger of a collapse is over. Experts from New York made the changes.

INJUNCTION REMOVED.—The last injunction restraining the Buffalo Traction Company from laying tracks in any part of the city has been removed and the work of construction will begin at once. The lines will be built by the Erie Construction Company, New York. The attorneys of the company have filed the consents of the stockholders to grant a first lien upon all its property and franchise to the Central Trust Company, New York. The lien is issued as a mortgage to guarantee the issuance of $5,000,000 worth of bonds, at the rate of $50,000 for each mile of track constructed. The bonds are to be of a denomination of $1000 each, to run for forty years. They will bear interest at 5 per cent.

PITTSBURG NOTES.

PITTSBURG, PA., April 12, 1897.

THE SECOND AVENUE TRACTION COMPANY has completed arrangements for building a viaduct across the tracks of the P. V. & C. Railroad at Dravosburg. At present the passengers by this line between Pittsburg and McKeesport are compelled to make an annoying transfer at this point, as a grade crossing would not be permitted. After the completion of the viaduct cars will be run through from Pittsburg into McKeesport without a transfer.

THE ALLEGHENY COUNTY LIGHT COMPANY will this week begin once more its interrupted work of laying underground conduit for its wires and cables. An ordinance prohibits the tearing up of the streets between November 15 and April 15, and since the work began last Spring could not be finished in one season a number of streets had to be left until this year. The company hopes to have all of its underground work completed this Summer. The conduit used is exclusively the cement-lined, wrought-iron pipe furnished by the National Conduit Manufacturing Company, New York.

NEW ELECTRIC RAILWAY.—A company has been organized to build an electric railway from Meadville to Erie. An air line between the two cities is only about 33 miles long, but in order to reach prospective traffic and to take advantage of easy grades the route selected for the line will be about fifty miles long. Freight as well as passengers will be carried and the expectation is that the road will in time secure a great deal of mail and express business. The road will pass through the important health resorts of Saegerstown and Cambridgeboro and several other good-sized towns. Two power houses will be required to supply current for the road. Meadville and Pittsburg capitalists are interested in the enterprise.

Cleveland Notes.

Cleveland, O., April 10, 1897.

NEW TROLLEY WIRE.—The City Commissioners have ordered the Akron Street Railway Company, Akron, Ohio, to equip its whole line with new trolley wire, declaring that the present wires are old and unsafe.

A LARGE CONTRACT.—The Chase Constructing Company, Detroit, Mich., has just been awarded the contract for the entire overhead construction for the Lorain & Cleveland Railway, work to be commenced at once.

WILL USE ELECTRICITY.—The Cuyahoga County Commissioners are in favor of putting in an electric plant for lighting the County buildings in this city. It is therefore thought that the project will be carried out in the near future.

NEW FRANCHISE.—The Lorain County Commissioners at a meeting April 8 granted the Cleveland & Lorain Electric Railway Company a franchise to build its road to Oberlin. If it is granted a franchise by the Oberlin Council work will be commenced at once.

WILL RESUME OPERATIONS.—The Globe Carbon Company, whose plant is located at Ravenna, Ohio, and which is composed of Cleveland capitalists, is making preparations to start work in the near future. The starting of the plant will afford employment to a large number of men.

FIFTY-YEAR FRANCHISE.—Superintendent John J. Stanley, of the Cleveland Electric Railway Company, stated yesterday that his company was making no effort to secure the passage of a fifty-year franchise ordinance from the newly-elected City Council. He further stated that the subject had not been discussed by the officials of the company.

EXTENSION OF TIME.—The Commissioners of Cuyahoga County have granted an extension of time to the Wooster, Medina & Cleveland Electric Railroad Company to commence work on its line. The company was to begin work on March 28, but claimed that it would be unable to do so. It was given until December 31 to get ready and must have its tracks laid by December 31, 1898.

MR. A. W. KILBOURNE has closed a contract with the Ohio Storage Battery Company, Cleveland, Ohio, to assume the general agency for the sale of its products. This company has made arrangements to put in some new machinery and enlarge its shop capacity, and will be generally active along the lines of its business this Summer. Mr. Kilbourne is about to take an extended trip to the Eastern and Middle States, and will doubtless meet with great success in his new business venture.

DIVIDENDS DECLARED.—At a recent meeting of the Board of Directors of the Cleveland Electric Railway Company a quarterly dividend of three-quarters of 1 per cent. was declared and made payable April 5. At a meeting of the Board of Directors of the Cleveland City Railway Company held last Wednesday they declared a dividend of three-quarters of 1 per cent. to be paid April 10. This is the first dividend that has been declared by this company since April, 1896. It is stated that dividends will be paid regularly hereafter.

THE AHLM-EDWARDS ELECTRIC COMPANY, Medina, Ohio, has found its present accommodations in that city inadequate to meet the growing demand for its apparatus, and has decided to move its factory to Cleveland, where ample facilities will be afforded for promptly filling orders for its well-known lines of dynamos and motors. The company is now manufacturing dynamo and motors up to 1000 lights or 50 horsepower, and the steady increase of its business speaks volumes for the excellence of its machines.

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., April 10, 1897.

THE FESSENDEN MANUFACTURING COMPANY, of Pittsburg, Pa., has opened an office in the Monon Building, Chicago, for the sale of its Rontgen ray apparatus, and also its long-burning arc lamp. The Western office has been placed in charge of Mr. E. S. Lea, who has until recently been superintendent of the company's works.

MR. A. D. CHANDLER, Western manager for the American Circular Loom Company, has recently received the appointment of Western representative of the Cutter Electrical & Manufacturing Company, Philadelphia. Mr. Chandler is not only very popular in the West, but is also a very hard worker, and his friends are sure that he will make a "killing" with the I. T. E. automatic circuit breakers, and C. S. switches.

FINE PLANT.—Last week a representative of The Electrical World visited the new power station of the West Side Park, in Chicago, and saw the Excelsior 150-light arc dynamos in operation. The apparent ease with which they carried their load and their beauty of design excited his admiration. The present plant consists of seven 150-light machines, each maintaining a pressure of 7500 volts, running at a speed of 650 revolutions per minute. Instead of driving these machines by belt, as is the ordinary custom, the European method of driving by ropes has been carried out in this instance. The plant was installed under the supervision of Mr. Foree Bain, and its operation reflects great credit upon his engineering ability.

St. Louis Notes.

St. Louis, Mo., April 12, 1897.

THE NATIONAL CONDUIT AND CABLE COMPANY, of Hastings, N. Y., has leased a tract of land and building, and will manufacture the material used in placing the wires under ground here. The company has secured contracts from the Edison Illuminating Company, the Missouri Electric Light Company and the St. Louis Electric Light & Power Company, and will manufacture the cement-lined conduits to be used by these companies. The lease is for one year, with privilege of extension to five years. The new factory will employ about 200 men.

MUNICIPAL PLANT.—The electric light companies, in holding out for more favorable specifications on the municipal lighting contract, may cut their own throats, and the city may do its own lighting later on. A proposition was made to the city by the Manufacturers' Association to organize a company to furnish electric light at a price amounting to the average rate paid by other cities, the plant to be built from the proceeds of the sale of bonds, and the bonds to be taken up by a sinking fund. At the end of fifty years, or when the bonds shall have been retired, the plant becomes the property of the city.

NO BIDS TENDERED.—The Board of Public Improvements held a special meeting last Friday to open the bids for the new lighting contract. No bids were received and the Board was disappointed. It seems as if the electric lighting companies were afraid that the work embraced in the contract was much more expensive than it really is. Members of the Board think that the electric light companies have formed a combination for forcing the city to treat with them on easier terms. Others think that they are afraid of guaranteeing the city arc lights of 700 candlepower when the lamps now in use are supposed to be of 1000 candlepower, and were trying to force the city to a less rigorous set of specifications and more flexible contract. The representatives of the various electric light companies say that they did not bid because of the rigorous provisions of the contract, which they could not possibly fill without financial ruin to their companies.

Pacific Coast Notes.

San Francisco, Cal., April 3, 1897.

THE SAN JOSE & SANTA CLARA RAILWAY COMPANY'S system will be reconstructed. Henry O'Dogherty has the contract for the work, and he can be addressed in care of the company, San Jose, Cal.

ISOLATED PLANT.—The new building to be erected in San Francisco by the proprietors of the *Daily Examiner* will have an isolated electric plant. The plans and specifications are being prepared by Consulting Engineer E. R. Knowles, 140 Nassau Street, New York City.

ELECTRIC POWER IN JUNEAU.—A new electric mining plant is being installed at the Silver Queen mill, in Juneau, Alaska. The Alaska-Juneau Company, owner of the Lane Campbell property, will install an electric plant on Salmon Creek and erect a mill on tide water. A 1000-foot shaft will be commenced soon.

PARK LIGHTING.—Golden Gate Park, San Francisco, will have an electric lighting plant, the estimated cost being $40,000. An underground system of distribution is contemplated. Grading for the power station will be commenced at once. The electric equipment will not be secured until next Summer, when the funds will be available. The Union Iron Works donated the station plans to the Park Commissioners.

NEW ELECTRIC MINING PLANT IN NEVADA.—The Westinghouse Electric & Manufacturing Company recently sold, through its San Francisco agency, a new electric mining plant to Charles Lane, of Nevada. The main features of the installation will be a 250-hp two-phase dynamo, which will generate current at 2,200 volts, and a 150-hp induction motor. Several large orders for electric motors have been received from the Los Angeles Electric Company.

A LARGE MINING PLANT.—A Tacoma report has it that the Treadwell Gold Mining Company, Douglass Island, Alaska, will erect a mill having 300 additional stamps. Work has been commenced on a 1000-foot, five-compartment shaft. The water and steam power plants will be supplanted by an electric system. The plans call for two generators of 5000 hp each. The complete installation will cost $500,000. The San Francisco representative of the Treadwell Company states that the announcement of the installation of a large electric power plant is premature, and it will probably be two years before such a change will be made.

Canadian Notes.

Ottawa, Ont., April 10, 1897.

TRAFFIC INTERRUPTED.—The traffic on the Montreal Park and Island Railway, Montreal, was interrupted on April 7, through the burning out of a generator in the power house, and as a consequence the service was brought to a standstill on all lines. All the cars were running again within twenty-four hours.

THE QUEBEC ELECTRIC RAILWAY.—It is expected that early in the month of June next the Quebec Electric Railway will be in working order in the lower part of the city. As soon as the frost disappears from the ground Mr. Evans, manager of the road, will have three or four hundred men at work. There are eleven cars now in readiness in this city to be shipped to Quebec, and they will be of the same dimensions as those used in Montreal.

A TORONTO SYNDICATE, which has been securing options on the stock of the Street Railway Company of the City of Hamilton, Ontario, has laid before the Mayor and Aldermen an important proposition looking to the control of the electric railways in that city. It is proposed that a company to be known as the Hamilton Franchise Company, shall be formed, to acquire from the syndicate the property upon which it has options, including the Hamilton and Dundas railway. The syndicate will accept its pay half in stock of the company and half in

bonds. The interest on these bonds is to be first charged on revenue of the company; then at 6 per cent. dividend on stock, after which the city is to receive all the balance of the net revenue up to $20,000, when the stockholders may receive another 1 per cent., and the city all the remainder. The city is to relinquish its mileage and percentage, which now amount to about $14,000 annually. There are other features of the proposition, but these are the most important. The syndicate is said to be composed of men who own the Toronto Street Railway, and similar lines in other cities.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, March 31, 1897.

GOVERNMENT TELEGRAPHISTS.—There is at present considerable ferment amongst postoffice telegraphists in this country owing to the recent report of the committee which was specially appointed to enquire into the many grievances of the postoffice employees. The recommendations of the committee have apparently appeased the postal branch of the service, but have only excited the ire of the telegraphists, who consider themselves unfairly treated as compared with their colleagues.

AN ELECTRIC RAILWAY ON THE THREE-WIRE SYSTEM.—A short tunnel electric railway which is now occupying the attention of a Parliamentary Committee, presents some points of interest for electrical engineers. Owing to the impossibilty of finding a suitable site close to the terminus of the line or along the route, it was decided to secure a river-side location about two miles from the nearest terminus. This position renders necessary the use of a much larger voltage than the regulation 500, and to avoid the cumbersome expedience of huge motor transformers, transmission at 1200 volts and the subsequent splitting of the pressure has been decided upon. The positive wire will be taken along the up tunnel and the negative in the down tunnel, the inner consisting of the rails and steel tubes, balance being maintained by balancing transformers distributed along the line.

SMALL ELECTRIC LIGHT UNDERTAKINGS.—Whenever a local authority in this county wishes to borrow money for any public purpose, it is the rigorous rule that an Inspector, deputed by the Local Government Board, should be sent down to hold a local inquiry, and permission to borrow is only given after a favorable report is received from this functionary. This system has worked out very well so far, and is an admirable protection to the ratepayer from extravagance on the part of his elected representatives. Sometimes, however, the procedure seems somewhat ridiculous even to the British mind. Just recently the mining village of Treeton near Rotherham in Yorkshire, decided to light itself by means of electricity and to spend the large sum of £600 for this purpose, and accordingly a Local Government Board inspector, (a full blown Colonel in the Royal Engineers) was sent all the way down from London to inquire into the proposed expenditure of £600, of which no doubt, his own expenses will form no small percentage. No doubt, however, the expenditure of £600 to Treeton bears the same relation to the rateable value as would an expenditure of £600,000 to the rateable value of nearby Manchester.

TRANSMISSION OF POWER.—A lecture on the "Transmission of Power to Long Distances by Alternate Currents of Electricity" was given by Mr. W. B. Esson before the Society of Arts on Wednesday, March 24. The subject was taken up at the point where Mr. Gisbert Kapp left it in his 1891 Cantor lectures, and it will be remembered that in the conclusion to these lectures Mr. Kapp briefly commented upon the then quite new theory of polyphase motors, which he described as "leaving the safe ground of solid facts and engineering practice to enter into the domain of speculation." The prediction Mr. Kapp made at that time had, the lecturer said, been amply justified, and the subject of Mr. Esson's lecture was practically a review of the developments of polyphase transmission since that date. The lecture was divided into three parts dealing respectively with generators, line, and motors. Considerable importance was attached to the power factor, which, it was rightly argued, must be as large as possible, and it was shown how considerably small polyphase motors are handicapped by the low power factors which they usually have. As regards the form of the E. M. F. curve of the generator Mr. Esson votes entirely for the pure sine curves, and states that "experience has shown what one might almost have arrived at by intuition, viz.: that for smooth running a simple harmonic curve is best of all." Regarding the relative merits of two-phase and three-phase plants Mr. Esson is again very certain, and he advocates the former system. He admits that the three-phase system enables some copper to be saved in lines, but asserts that this is practically its sole advantage, "while it must be remembered that not until the distance exceeds 25 miles does the saving in copper over the two-phase system amount to anything like 5% of the total cost of the scheme." "Considering the simplicity of the two-phase system," he says, "and the ease with which it can be worked as compared with three-phase, especially where lighting is combined with power, it seems that the saving in copper is so small a fraction of the whole cost as not to be worth considering." Finally Mr. Esson has a good word to say for the monocyclic system, which, however, time did not permit him to describe in detail. In the discussion which followed the reading of this paper the partisans of continuous-current motors were represented by Mr. Alex. Siemens and Mr. Harris, who seemed very anxious that the audience should not believe that the polyphase system was the only available means to transmit large power over great distances. Indeed, these gentlemen asserted their belief that continuous currents were simpler and better in all respects than polyphase currents for the transmission of motive power.

General News.

NEW INCORPORATIONS.

THE AHLM-EDWARDS ELECTRIC COMPANY, Medina, Ohio, has been incorporated by C. E. F. Ahlm. Capital stock, $25,000.

THE SEABRIGHT ELECTRIC LIGHT COMPANY has been incorporated at Long Branch, N. J., by Dr. James J. Reed, E. S. Nesbit and L. G. Irwin. Capital stock $10,000.

THE SENTINEL ELECTRIC COMPANY, Wilmington, Del., has been incorporated by Samuel N. Trump, C. Reginald Van Trump and George R. Hoffecker. The capital stock of the company is $50,000.

WESTERVILLE ELECTRIC LIGHT, POWER & WATER COMPANY has been incorporated at Westerville, Ohio, with a capital stock of $40,000. Those interested are N. B. Abbott, G. W. Meeker and James Westwater.

THE AMSTERDAM ELECTRIC LIGHT, HEAT & POWER COMPANY, Brooklyn, N. Y., has been incorporated with a capital stock of $500,000. The incorporators are Frank G. Writer, Edward J. Prest and Henry Heale.

THE NATIONAL CONDUIT CONSTRUCTION COMPANY, St. Louis, Mo., has been incorporated with a capital stock of $2000. Those interested are J. P. McQuaide, Fred. W. Abbott, David C. Gamble and Edmund T. Allen.

THE TRENTON & MOHAWK VALLEY POWER COMPANY, Utica, N. Y., has been formed with a capital stock of $500,000 by Angelo W. Myers, Richard A. Cunningham, Edward J. Slattery, William A. Chipman and William Pierrepont White.

THE ELYRIA & OBERLIN ELECTRIC RAILWAY COMPANY, Elyria, Ohio, has been incorporated with a capital stock of $100,000, by A. E. Aikens, F. T. Pomeroy, S. Smith and A. G. Hutchinson. The headquarters of the company will be at Berea, Ohio.

THE OHIO & MICHIGAN TELEPHONE COMPANY, Wauseon, Ohio, has been incorporated by James F. Brailey, J. F. Brailey, Jr.; Edward L. Barber, F. J. Spencer and H. A. Barber. Capital stock, $5000. The new company intends to operate a telephone line from Wauseon to Fayette.

THE BUFFALO, NIAGARA RIVER & GRAND ISLAND RAILWAY COMPANY, Buffalo, N. Y., has been organized with a capital of $30,000. The company will operate a street electric railway from O'Neil and Tonawanda. The directors are Herbert P. Bisell, J. Henry Metcalf, Donato A. Crage, George A. Ricker and others, of Buffalo.

THE ELYRIA TELEPHONE COMPANY, Elyria, Ohio, has been formed by Parks Foster, S. B. Ravens, J. S. Brailey, Jr., James F. Brailey and E. L. Barber. Capital stock $20,000. The purpose of the new company is to construct lines in Lorain, Erie, Huron, Ashtabula, Medina and Cuyahoga Counties.

THE UNITED STATES BATTERY COMPANY, New York City, N. Y., has been incorporated to manufacture electric batteries and machinery. Those interested are Albert C. Johnson, Lilian H. Andrews, Henry P. C. Johnson and O. T. Bugg, of New York City, and A. L. Helwig, of Stapleton, S. I. Capital stock $25,000.

THE OSSINING HOME TELEPHONE & TELEGRAPH COMPANY, Sing Sing, N. Y., has been incorporated with a capital stock of $25,000. The incorporators are Louis M. Simpson, New York City; G. H. Atkinson, Jersey City; Franklin Noble, Brooklyn; E. L. Ryder, John McNally, Edward F. Sheehan and John Gibney of Sing Sing.

THE PAN TELEPHONE COMPANY has been organized at Fort Smith, Ark., with a capital stock of $15,000. The incorporators are L. E. Ingalls, Chicago, Col. W. H. H. Clayton and James Brizzolara. The company is formed to own and operate telephone exchanges and manufacture and sell telephones and telephone supplies. The plant of the Arkansas Telephone Company at Fort Smith, it is stated, will be transferred to the new company by the Harrison International Telephone Company.

THE RAPID TRANSIT UNDERGROUND RAILROAD COMPANY was incorporated at Albany, N. Y., on April 9, for the purpose of constructing a tunnel railroad in New York City, from City Hall Park to 155th Street, a distance of ten miles. The incorporators and directors of the corporation are Carlton H. Reeve, Cornelius V. Sidell, John Bogart, John Acken, David L. Hough, John F. O'Rourke, Thomas Allen and Robert H. Sherwood, of New York City, and Nelson S. Easton, of Summit, N. J.

TELEGRAPH AND TELEPHONE.

COLUMBIA, TENN.—It is stated that a telephone line will be built from Columbia to Theta by way of Jameson.

CAMERON, OHIO.—A telephone line is being built between this place and Clarington, and will be continued to Woodfield later on.

WAUSAU, WIS.—The telephone war in this place has reached such a point that the Wisconsin Telephone Company has been giving free concerts to the citizens.

BARNESVILLE, OHIO.—A telephone line is completed between this place and Woodfield, via Benwood and New Castle. The line will be a great convenience to the people in the places named.

PORT HURON, MICH.—It is stated that the State Telephone Company has purchased the Harrison plant in this city and will build a line to Detroit, touching at St. Clair, Marine City and Algonac.

RICHMOND, IND.—There is some talk of organizing a telephone company to compete with the Central Union Company. Mr. Elisha Holbrook, of Muncie, Ind., it is stated, is at the head of the new enterprise.

MINNEAPOLIS, MINN.—It is stated that a new telephone company is being organized by Minneapolis and St. Paul citizens, and that the system to be used is that of the Drawbaugh Telephone & Electric Appliance Company.

MONROE, MICH.—The Common Council has granted a telephone franchise to W. C. Sterling and W. C. Sterling, Jr., who will build and operate a telephone exchange in this city in connection with the new State Telephone Company.

ABERDEEN, S. D.—The Dakota Central Telephone line will be extended from Redfield to Watertown. The distance between the two places is seventy miles. It is stated that Aberdeen will eventually be connected by telephone with the Twin Cities.

MENOMINEE, MICH.—Information has reached here that the Commercial Telephone & Equipment Company has been organized in this State to build and equip local exchanges throughout Michigan. This company, it is stated, represents the Stromberg-Carlson telephone.

TOPEKA, KAN.—John R. Mulvane, president of the Missouri & Kansas Telephone Company, states that the wires of the Topeka plant will be put under ground as soon as the work of putting the Kansas City wires under ground is completed. He estimates that the expense will be about $50,000.

MT. CLEMENS, MICH.—The Bell Telephone Company has reduced its rates a little lower than those of the State Telephone Company. The latter charges $18 for private residences, while the Bell has put its rate at $12. The two companies charge the same for business instruments, namely, $24 per year. The State Company claims to have 112 five-year contracts in this city.

INDIANAPOLIS, IND.—The Postal Telegraph Company has completed the work of placing its wires under ground within the mile square. The work has been done under the supervision of Mr. E. S. Reid, of the National Underground Cable Company, New York City. In all six miles of poles and 144 miles of wire have been removed from the streets. The underground cables are lead-sheathed, each containing from 20 to 75 wires.

Electric Light and Power.

EDINBURG, IND.—The Edinburg Town Council has practically decided to put in an electric plant.

SCOTTSVILLE, N. Y.—There is a prospect now that Scottsville will have an electric light plant in the near future.

DALLAS, TEX.—The citizens will vote on the question of issuing $50,000 in bonds to be used in establishing a municipal lighting plant.

LOCKPORT, N. Y.—The bill authorizing the city of Lockport to expend $50,000 for an electric light system was passed by the Assembly.

GREENPORT, L. I., N. Y.—A movement is on foot to have the village of Greenport bonded for $50,000 for the purpose of supplying the village with water-works, electric lights and sewers.

BAR HARBOR, ME.—Work on a new electric light station at Bar Harbor will be begun in August. It will be built of brick with concrete floor and iron roof, and will cost in the neighborhood of $7,000.

LE ROY, N. Y.—The question as to whether Le Roy shall own its electric lighting plant was voted upon at a special election and carried by 35 majority.

CANANDAIGUA, N. Y.—It is stated that the Canandaigua electric light plant will soon be transferred to a Buffalo syndicate, who will operate the Littleville plant and extend the present Canandaigua trolley lines to Manchester.

BELLEFONTE, PA.—The plant of the Electric Illuminating Company in this city, with all its contents, was destroyed by fire on the night of April 6. As a result of this disaster the entire city was in darkness for several nights. The loss is estimated at $35,000, with $13,000 insurance.

LOS ANGELES, CAL.—The Wybro & Lawrence Company, of this city, has secured the contract for installing the new municipal electric light plant at Anaheim, Cal. This plant will include a 60-kw alternating-current dynamo, with exciter and switchboard instruments, alternating-current arc lamps and pole line; several assorted sizes of transformers; a 100-hp engine and water tube boiler for burning crude oil; boiler feed pumps, etc. The city will furnish light for the streets and also to private consumers.

APPLETON, WIS.—The rate war which has existed for a year or more between the Citizens' Electric Light Company and the Appleton Electric Light & Power Company, has finally been settled by the sale of the property of the former to the latter company. The consideration, it is stated, was $25,000. The Citizens' Company was organized to fight the old concern, and the resulting cut prices were so low that neither of the companies could make money. It is understood that there will be an immediate advance in rates.

The Electric Railway.

PHILADELPHIA, PA.—Architect and Engineer W. B. Twining, Ninth and Dauphin Streets, is having plans prepared for the rebuilding of the power house located at Ridge Avenue and Thirteenth Street for the Union Traction Company.

CANONSBURG, PA.—A new electric line is being contemplated between Carnegie and Canonsburg.

HANNIBAL, MO.—The Hannibal Railway Company will reconstruct six miles of track. A power house will also be erected.

PALMYRA, N. Y.—It is an assured fact that a trolley line will be built during the coming Summer from Palmyra to Marion, a distance of seven miles.

AUBURN, N. Y.—The Auburn & Western Railroad Company is asking for a franchise to construct a trolley line from Auburn to Cayuga.

COLORADO SPRINGS, COL.—A street railway franchise has been granted to Wallace Hooks to build and operate street car lines on various streets of the city.

BURLINGTON, VT.—Petitions are being circulated in this city, Winooski and Essex Junction pleading for the extension of the electric railroad to Queen City Park.

COXSACKIE, N. Y.—New York and Albany capitalists state that they will build a trolley railroad from Coxsackie to Greenville and Oak Hill, and may be to Middleburg.

BELLINGHAM, MASS.—The street railway authorities will meet the Bellingham and Medway Selectmen and look over the proposed new route to Carysville from the Milford road.

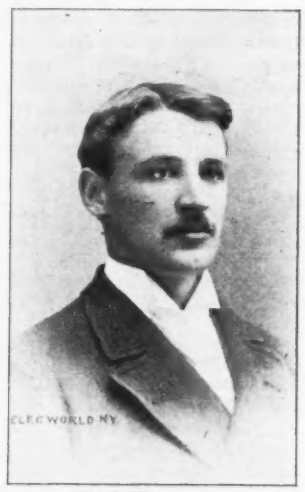
BURLINGTON, IOWA.—The Burlington Electric Railway was sold to a Boston syndicate on April 10 for $50,000. It is stated that $100,000 will be spent on improving the road during the coming Spring.

WASHINGTON, D. C.—The American University authorities and parties interested in the adjoining property are endeavoring to arrange for a branch railroad to run through the property lying on the present lines of Glen Echo, Tennallytown and Great Falls Railroad.

Personal Notes.

MR C. E. F. AHLM was graduated from the Royal Polytechnical College in Stockholm, Sweden, in 1891, and soon afterward accepted a position with the Wenstrom Company of the same city. In 1892 he entered the service of the old Thomson-Houston Electric Company in Lynn, Mass., devoting much of his time in the factory and draughting room. During 1893 he went through the expert course of the General Electric Company at Lynn works, and acquired a practical experience in the construction and handling of electrical apparatus. In the Fall of the same year he entered the employ of the Walker Manufacturing Company,

C. E. F. Ahlm.



H. J. Edwards.

just at the time this concern began the manufacture of electrical machinery. During his two years' connection with the Walker Company he designed all its dynamos and motors, which machines have proved eminently successful and given the Walker Company a wide reputation. After severing his connection with this company he became associated with the E. & C. Electric Company, of Cleveland, Ohio, as its electrical engineer, and designed for this company a line of small dynamos and motors, which in excellence have proven unsurpassed. In the fall of 1896, Mr. Ahlm, together with Mr. H. J. Edwards, organized the firm now known as the Ahlm-Edwards Electric Company, and established their works in Medina, Ohio.

MR. H. J. EDWARDS, who has been connected with the electrical business for several years, graduated in 1891 from the City and Guilds of London Technical College, Finsbury, England, having had Prof. Silvanus P. Thompson as a tutor. In the Fall of the same year he entered the service of the Brush Electric Company, Cleveland, Ohio, where he acquired considerable experience in the shop and draughting room and engineering department. Mr. Edwards is entitled to considerable credit in connection with the successful development of the Brush Company's large arc machines with the new automatic regulators. In the production of these machines, Mr. Edwards displayed commendable perseverance and ingenuity. In the Spring of 1895 he resigned his position with the Brush Electric Company, to accept an offer in the engineering department of the Walker Company, where he gained large experience in the design of multipolar dynamos and motors. In the Fall of 1896 Mr. Edwards entered into partnership with Mr. C. E. F. Ahlm in the organization of the Ahlm-Edwards Electric Company, Medina, Ohio.

Trade and Industrial Notes.

THE H. N. BATES MACHINE COMPANY, 240-246 Congress Street, Boston, Mass., has opened a New York office at 136 Liberty Street, with Mr. Fred R. Lord as manager of the same.

MESSRS. J. JONES & SON, 67 Cortlandt Street, New York, have issued a special price list on Paragon motors of all sizes. Those interested in this line of goods should communicate with this firm.

WIRING AN ARMORY.—The Armory Board has awarded the contract for wiring the 7th Regiment Armory in New York City to James F. Buchanan & Co., Philadelphia. The contract price is $23,400.

THE NEW YORK DYNAMO & MOTOR COMPANY, 257 Broadway, New York City, has taken the agency for New York City for Messrs. Roth Bros. & Co., Chicago. Mr. A. Farina is the manager of the company.

FAN MOTORS.—The Western Electric Company, Chicago and New York, has issued an artistic 20-page booklet on fan-motors, which gives illustrations and descriptions of these machines as made by that company, as well as complete list prices for the different finishes. A copy may be had on application.

THE IMPERIAL ELECTRIC COMPANY, 140 Washington Street, is busily engaged in building its new slow-speed motors recently described in THE ELECTRICAL WORLD. These machines are being extensively used for the operation of linotype type-setting machines. The motor has been improved in certain details, and is now entirely enclosed, so that it is proof against injury.

THE AMERICAN ELECTRIC TELEPHONE COMPANY is now established at 171-173 South Canal Street, Chicago, where it has increased facilities and first-class modern appointments, which will enable the company to give better attention to its expanding trade than was possible at the Kokomo factory. The company's office and factory are now located at Chicago.

MR. R. B. COREY has recently taken charge of the sale of the Columbia incandescent lamp, in the Eastern territory, in addition to his other electrical lines. He will be pleased to have his friends call upon him at his office in the Havemeyer Building, New York. Mr. Oscar Hoppe, who was manager of the Columbia Lamp Company during the past year, is associated with Mr. Corey.

NEW TYPE OF ENGINE.—The Armington & Sims Engine Company, Providence, R. I., is building a new type of automatic engine which possesses some marked features. It is built simple, tandem and cross-compound, condensing and non-condensing, for belt and direct-connected service. The engine was designed especially for heavy duty, such as railway work, and it is very simple in construction.

THE OHIO ELECTRIC WORKS, 13 South Water Street, Cleveland, Ohio, reports that its bicycle electric lamp is meeting with a satisfactory reception and is giving the best of satisfaction to all who use it. The light does not jolt out and in other respects the lamp is much appreciated by bicyclists. A request will bring a circular with a full description of this and other electrical novelties.

THE MICHIGAN PIPE COMPANY, Bay City, Mich., manufacturer of creosoted conduits for underground wire, and improved Wyckoff water pipe, has rebuilt its works, which were destroyed by fire on Dec. 8, 1896. The new mill is equipped throughout with new machinery and appliances, and the company has many orders to fill for creosoted wooden conduits, creosoted telephone cross arms and mine pipes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., reports that it is rapidly closing agency arrangements in different parts of the country for its 1897 line of fan motors and ceiling fans. It is offering a full line of direct and alternating fan motors, and also a full line of direct and alternating-current ceiling fans. The company is prepared to make attractive arrangements with good live agents.

TROLLEY WIRE HANGER.—In THE ELECTRICAL WORLD of April 3 an illustrated description was given of a trolley wire hanger made by the Ohio Brass Company, Mansfield, Ohio. Through inadvertence the captions of the two bolts shown became transposed. That designated as "Type D Bolt" should have been the "Type D. W. Bolt," and the one with the latter caption should have been named the "Type D. Bolt."

MR. FRED. M. LOCKE, Victor, N. Y., manufacturer of high potential line insulators, etc., is now directing his efforts to the lines of the steam railroads. His cross-arms, pins and insulators are now used on the entire system of the Lehigh Valley Railroad, part of the New York Central & Hudson River Railroad, and part of the Delaware & Hudson Railroad. His line material is extensively used on high potential transmission lines throughout the country.

THE PEERLESS RUBBER MANUFACTURING COMPANY, 16 Warren Street, New York, has just issued its catalogue No. 24, which describes and illustrates in colors its various rubber products. This company manufactures mechanical rubber goods for all uses, and its "Rainbow" and other steam packings are well known among the electrical and steam interests. This company produces manufactures of all kinds where rubber enters as a factor.

NEW POWER STATION.—The Worcester & Marlboro Street R. R. Co., Worcester, Mass., is erecting at Northboro, Mass., a new power station. The engine room is 55 feet wide and 63 feet long, and the boiler room is 45 feet wide and 40 feet long. The roof, which is to be gravel on plank, is supported by steel trusses. Cutting & Bardwell, Worcester, Mass., are the general contractors for the work, and the steel work will be erected by The Berlin Iron Bridge Company, East Berlin, Conn.

FIRE.—The works of the Forest City Electric Company, Cleveland, Ohio, were damaged by fire on the night of April 12. A large amount of belting, pulleys, etc., were destroyed, and the interior of the building was damaged to a considerable extent; fortunately, however, the machinery received no damage whatever. The company expected to have its works in complete running order again in three days, and if necessary run them night and day to avoid any inconvenience to customers.

OF INTEREST TO MANUFACTURERS.—It is the purpose of the proprietors of the *Canadian Manufacturer and Industrial World*, which is published in Toronto, Ontario, to issue a special edition of that journal containing the new Canadian tariff and the new United States tariff, also the British tariff and the British Merchandise act, as soon as they become law. These laws will be reprinted from copies obtained from official sources and will be correct. No doubt a copy of this paper will be valuable to every manufacturer.

MACHINE-TOOL CATALOGUE.—The Garvin Machine Company, Spring and Varick Streets, New York City, has just issued a very complete catalogue and price-list of its large line of machine tools. A great many of these are excellently illustrated and a brief description of each is given. The machines made by this well-known concern include universal and plane milling machines, screw machines, hand lathes, gear cutters, tapping machines, drill presses, cutter grinders, forming machines, profilers, etc. The catalogue has 158 pages, and at the back is given a telegraphic code, also a very complete index of contents. Considerable engineering information, including tables to facilitate mechanical calculations, is also given.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., seems to be enjoying quite a boom under the management of Mr. Frank H. Ball. Since the first of the year it has been found necessary to increase the capacity of its works, and now it is installing a regular all-night working force, so that the establishment can run night and day hereafter. Among the recent shipments the following are reported: Cincinnati Commercial Tribune, one 78-kw dynamo; Cliff Paper Company, one 50-hp motor, one 25-hp motor; Daily States Publishing Company, one 12-hp motor; Toledo Blade, one 12-hp motor; Cleveland Plain Dealer, one 25-kw dynamo; Bridgeport Post, one 9 kw motor; Rochester Times, one 12-hp motor; Daily and Weekly News, one 25-hp motor; Baton Rouge Advocate, one 5-hp motor; Hartford Post, one 25-hp motor; Kansas Farmer, one 12-hp motor; The Register Company, one 15-hp motor; Syracuse Standard, one 9-kw dynamo; The St. Louis Star, one 50-hp motor; Weaver-Costello Co., one 9-kw dynamo; Minneapolis Journal, one 14x12 American Ball engine; Pennsylvania Silk Company, one 10x10 American-Ball Engine.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 6, 1897.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

579,975. MAGNET-ELECTRIC GENERATOR; W. Gillenette, New York. App. filed July 31, 1895. In a magneto generator the combination of a series of permanent magnets, with their extreme ends presented to the face of the armature with a shunting device, consisting of a sleeve of insulating material surrounding a shaft, and attached thereto a sleeve of conducting material having a flange at one end, both of such sleeves having an elongated slot in the same, admitting a carrying pin inserted in the shaft on which the insulating sleeve operates, with a spring attached to the conducting-sleeve to act as a recoil to the conducting and insulating sleeves, such sleeves being operated by a handle or other device, and such shunting device being attached to or in combination with a shaft driving a train or geared wheels.

580,010. KEYBOARD ATTACHMENT; H. W. Shonnard, New York. App. filed Aug. 24, 1895. In an electrically operated self-playing piano, the combination, with suitable key-operating mechanism, of a plurality of electrically-connected pivoted levers arranged on a stationary part of the piano, a contact block carrying a plurality of electric contacts with which the upper ends of the levers are by gravity made to engage, a sliding drawer arranged in front of and operating to move to and from the pivoted levers, music-sheet rollers journaled one above the other in said drawer, a slotted bar between said rollers and a perforated music sheet carried by said rollers and traveling over the slotted bar, the lower end of said levers being arranged to drop or pass through the perforations in said music sheet as the same is advanced.

580,011. ARMATURE CORE; S. H. Short, Cleveland, Ohio. App. filed Jan. 19, 1897. An armature core built up of laminae and having spacers interposed between the laminae and separated therefrom.

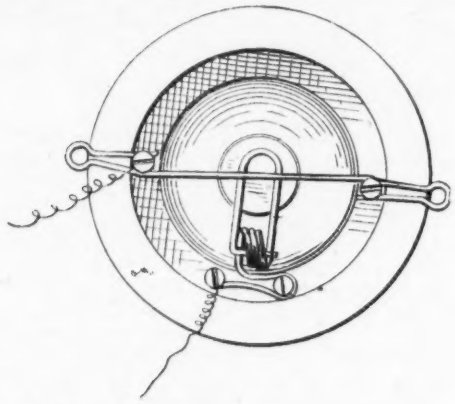
580,035. ART OF, AND APPARATUS FOR, GENERATING AND DISTRIBUTING MUSIC ELECTRICALLY; T. Cahill, New York, N. Y. App. filed Feb. 4, 1896. In an electrical music-generating system, the method of producing composite musical sounds electrically, which consists in (a) producing by induction, in different closed circuits, electric current undulations corresponding to different component sounds of the composite musical component sound desired; (b) synthesizing in a conductor resultant undulations out of the undulations produced, as above mentioned, in a plurality of closed circuits; and (c) translating the built-up electrical undulations into composite aerial vibrations of similar wave form.

580,057. ELECTRIC RAILWAY SYSTEM; W. Robinson, Boston, Mass. App. filed Jan. 21, 1895. The combination of a plurality of electromagnets included in a continuously closed circuit formed in part of two parallel lines of sectional contact conductors, said magnets being operated or controlled without opening the circuit of the same, an electric generator furnishing current to said magnets through said parallel sections of contact conductors, and means for demagnetizing each of said magnets in succession, independently of the others, by making short-circuiting contact between said respective parallel sections of contact conductors.

580,092. ELECTRIC PUSH BUTTON; R. L. Moore, Statesville, N. C. App. filed June 30, 1896. In an electric push button the combination with a cap of contact devices carried thereby, and fasteners comprising pieces of wire which are bent into eyes and secured to said cap, said fasteners being adapted to receive securing devices.

580,165. CABLE-ATTACHING DEVICE; J. Stephens, Forest City, Pa. App. filed Nov. 13, 1896. In a cable-holder, a pair of members arranged to open and close, and grooved or hollowed out inside to receive and hold a coiled portion of the cable, in combination with means for locking the sections together.

580,166. TELEPHONE CIRCUIT; J. S. Stone, Boston, Mass. App. filed June 26, 1895. In a centralized battery telephone system, the two



No. 580,092.—Electric Push Button.

conductors of a metallic telephone circuit connected in parallel as a single conductor with the main source of current supply and terminating at a sub-station in the two ends of the secondary of an induction coil, in combination with a local talking circuit containing the primary of said induction-coil, the telephone-transmitter and an electrolytic cell, the said local circuit being grounded or united to a return conductor between said transmitter and said electrolytic cell, and united to the middle of said secondary of the induction-coil between said electrolytic cell and said primary of the induction coil.

580,180. MAGNETO ANI DYNAMO ELECTRIC GENERATOR; C. H. Wade, J. Moores and H. O. Farrell, Manchester, England. App. filed Jan. 5, 1897. In magneto or dynamo electric generators an armature-coil divided into two or more sections a series of terminals to which the ends of each section are connected and which rotate with the armature, a contact adapted to slide over the successive terminals with variations of speed, and spring-controlled pin-rubbers for taking off the current.

580 206. ELECTRICAL TRANSFORMER; R. W. Blackmore, Peoria, Ill. App. filed Nov. 20, 1896. An electrical transformer plate having two openings for receiving a given coil of the transformer and provided with two cuts, one communicating from one hole to the outside edge of the plate, and the other communicating from one hole to the outside edge of the plate, and the other communicating from one hole to the other hole, and both cuts lying in a rectilinear line which coincides with an edge of each hole.

580,246. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; A. O. Babendreier, Washington, D. C. App. filed Oct. 26, 1896. In an electric railway conduit system, comprising a casing provided with outwardly projecting lugs at each end thereof, brackets fixedly secured to said lugs, and means for supporting said brackets within the conduit.

580,256. ELECTRIC ARC LAMP; W. J. Davy, London, England. App. filed Dec. 9, 1895. In electric arc lamps friction devices for controlling the motion of the carbon holder consisting of a friction surface geared to and moving with the carbon holder, a carrier adapted to be rotated round the axis of the friction surface, a brake-shoe pivoted on the carrier in close proximity to the friction surface, a lever mounted on the carrier, an articulated or joined connection between the brake-shoe and the lever whose effective length is altered on operating the lever to bring the brake into contact with the friction surface when the continued operation of the lever rotates the lever bodily with its fulcrum and the brake-shoe about the axis of the said friction surface, and a means for determining the position of the brake-lever according to the resistance of the arc.

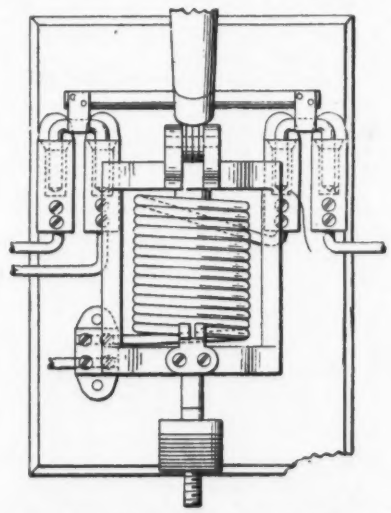
580,276. ELECTRO-MAGNETIC COIL; W. E. Harrington, Philadelphia, Pa. App. filed Jan. 15, 1896. An electro-magnetic coil having radially deep and axially narrow composite windings, said composite windings being made up of two or more separate bars connected in multiple, and the outer one or ones being coiled on those next within to form the composite windings.

580,277. MAGNETIC CIRCUIT BREAKER; W. E. Harrington, Philadel-

No. 580,165.—Cable Attaching Device.

phia, Pa. App. filed Jan. 15, 1896. In a magnetic circuit breaker the combination with an electric circuit and a switch-lever adapted to close and open said circuit, of a counterbalance rigidly attached to said lever and so constructed and arranged as to tend when the switch is closed to hold it closed, and when the switch is opened to carry it away from the circuit-terminals, an electromagnet, the coils of which are in series with the switch and an armature not normally in contact with the switch-lever actuated by said magnet and adapted to move under a predetermined current, arranged to impinge against the switch-lever and force it in a direction to open the circuit.

580,320. ELECTRICAL CUT-OUT; H. C. Jones, New York, N. Y. App. filed Aug. 12, 1896. In an electrical cut-out, the combination of a suitable casing provided with a longitudinal passage, recesses in its under side, and pendant protecting walls surrounding the longitudinal passage, insulated contacting points within the recesses between the pendant walls and the casing, and connected to the main



No. 580,277.—Magnetic Circuit-Breaker.

circuit wires, a cut-out plug having suitable contacting points and adapted to be slipped into the longitudinal passage of the casing and turned to bring the contacting points together.

580,335. ATTACHMENT FOR OPERATING TELEPHONE CALL BELLS; H. W. Libbey, Boston, Mass. App. filed Sept. 19, 1893. In combination with the bell-operating shaft of a telephone, a lever secured to the casing of the instrument, one end of said lever being over the push button, and the other having a block with a beveled hole through it, a cord passing through said block and wound around a spool adapted to rotate the bell-shaft when the cord is pulled out.

580,339. ELECTRICAL CIRCUIT CLOSER; O. F. Allen, Springfield, Mass. App. filed Dec. 18, 1896. In an electrical circuit closer, two electrodes normally out of contact, either or both coated with easily fusible conductive metal, in combination with a receptacle adapted to hold the molten fusible metal in contact with both electrodes.